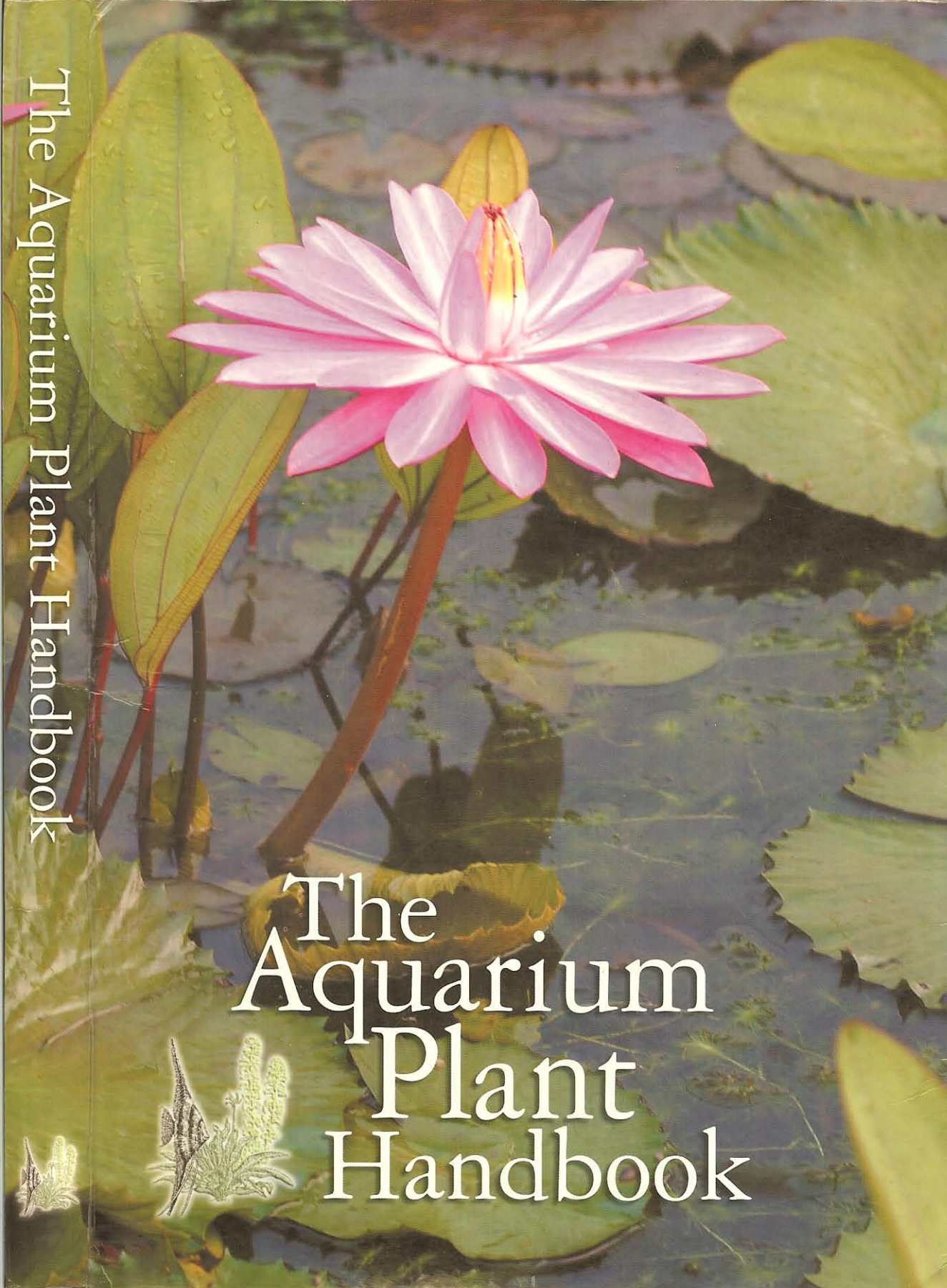
The Aquarium Plant Handbook



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Code Symbols

- Emersed
- Submerse
- Loose Plant
- Potted Plant
- Weigthed Bunch
- Bulb
- Mother Plant
- pH: - Acidity / Alkalinity
- Temperature
- General Hardness

  soft; soft-medium;

  medium-hard; hard
- Strong Lighting
- Medium Lighting
- Low Lighting
- Planting Position

  1 - Foreground

  3 - Mid-ground

  5 - Background
- Country or Region of Origin
- Stem Plant
- Rosette Plant
- Rosette Plant with Bulb
- Rosette Plant with Rhizome
- Rosette Plant with Tuber
- Easy
- Less Demanding
- Demanding
- Difficult

The codes used in this handbook refer to Oriental Aquarium-Singapore plant order codes.

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The Aquarium Plant Handbook

Dedicated to our founder,

Eu Tian Han

1931 - 2001

Foreword by Takashi Amano 4

Patron of Dynamic Fresh Water Ecosystem 6

Classification of Aquatic Plants 8

Cultivation of Aquarium Plants 12

Flowering & Non-flowering Aquarium Plants

- Algae 22
- Liverworts 24
- Mosses 26
- Ferns & Fern's Allies 28
- Flowering Aquarium Plants 36

Floating Plants 150

Terrarium Plants 159

Index 180

Guide to Symbols & Acronyms ..... Cover Flaps

Foreword

By
Takashi Amano

The aquarium hobby is said to have originated in the 18th century.

For the past three centuries, the aquarium hobby has evolved from merely keeping fish in "containers" to simulating the natural habitat using aquatic plants, driftwood and natural stones. Today, the aquarium is a very special confinement of space where fauna and flora coexist in a balanced environment. The hobby has also taken a quantum leap in deploying aquarium ecology techniques such as filtration systems, carbon dioxide supply and specialised lighting in maintaining harmony and equilibrium in the tank.

Although there are over 500 species of aquarium plants available to hobbyists, an exhaustive handbook is rather scarce. On this note, I would like to congratulate Oriental Aquarium's Aquatic Plant Handbook, which painstakingly explains the fundamentals of freshwater aquarium, natural ecosystem, plant classification and cultivation methods in an aquarium. Furthermore its pictorial format will find many delighted eyes!

I am sure this handbook will become a must-read "bible" for all aquarium hobbyists and enthusiasts.

Oriental Aquarium has been cultivating a variety of aquatic plants and marginal plants for well over 30 years. With the latest technology and processes, Oriental has been supplying aquatic plants throughout the world from their well-managed nurseries. In my opinion, Oriental Aquarium is undoubtedly the best plant nursery in the world in terms of its high cultivation technique and scale.

Oriental Aquarium's managing director, Mr. Eu It Hai, has been my friend for several years and it gives me great pleasure to see this handbook published and great honour to be part of its publication.

Patron of Dynamic Fresh Water Ecosystem

In nature, aquatic plants thrive in three different types of aquatic habitats, flowing water (streams and rivers), still water (ponds and lakes) and wetlands (swamps and marshes).

The role of aquatic plants in such dynamic aquatic ecosystem is so vital that the survival of other aquatic inhabitants such as fishes and other aquatic animals solely depend on its existence. As these plants, otherwise known as primary producers, serve as the basis of food chain. They form the primary source of food for herbivores and later these herbivores become prey to the carnivores. Plants are also the major source of oxygen for aquatic animals, its existence is crucial for maintaining the biological equilibrium of fresh water ecosystem.

As a connoisseur of nature, when we epitomise this vibrant fresh water ecosystem in the form of "Fresh Water Planted Aquarium" in our domestic environment, the outcome is the merger between art and science. Here, the plants and fishes are chosen on the basis of their ability to coexist in a friendly community without compromising the aestheticism.

Fresh Water Planted Aquarium is an inappropriate jargon, as it symbolises Dynamic Fresh Water Ecosystem. However, as this term is widely accepted all over the world, it is used throughout the text.

Imagine how artificial it will be when we keep some fishes without plants in a glass tank. An aesthetically set up planted tank becomes the natural home for the exotic fishes.

Classification of Aquatic Plants

As there is an array of classification systems on the basis of phylogeny (evolutionary trend) and it may change from time to time depending upon the entry of new fossil record of ancestral plants, in this book, a very basic one is described for aquarium plants in order to understand their position in the plant kingdom.

Major Taxonomic Divisions in the plant kingdom such as Bryophyta, Pteridophyta and Magnoliophyta have their representatives in the aquatic world.

Division Bryophyta (Liverworts and Mosses)

Plants belonging to this division do not have well defined vascular system to conduct water and food hence growth is restricted to moist areas. The diploid generation namely the sporophyte is totally dependant on the dominant and independent haploid generation, the gametophyte.

- **Class Hepatica (Liverworts)**

  The gametophyte of aquatic species is prostrate and thallose. The thallus is not differentiated into stems and leaves. Sex organs develop on the upper side of thallus. *Riccia fluitans* (Ricciaceae) and *Pellia endiviifolia* (Pelliaceae) are useful aquarium plants from this class .

- **Class Musci (Mosses)**

  Gametophyte is prostrate and extensively branched. The branch consists of an axis (stem) bearing spirally arranged leaf like appendages. These branches are anchored to the substratum by multicellular rhizoids. Sex organs are arranged at the tip of the branches. Aquatic species of this class include *Fissidens grandifrons* (Fissidentaceae), *Fontinalis antipyretica* (Fontinalaceae) and *Vesicularia dubyana* from Hypanaceae.

Division Pteridophyta (Ferns and Fern's Allies)

Sporophyte is more dominant than gametophyte. However, unlike Bryophytes, both sporophyte and gametophyte are physiologically independent of one another. The plant body has true leaves and roots with well developed vascular system (xylem and phloem) to transport food and water. The gametophye (prothallus) is very minute and inconspicuous.

It is subdivided into Lycopodiophyta, Equisetophyta, Psilotophyta and Polypodiophyta. Except Psilotophyta, all other subdivisions have their aquatic representatives.

- **Subdivision Lycopodiophyta**
  - **Class Isoetopsida (Quillworts)**

  The linear leaves are arranged in rosettes on a compressed stem. The sex organ (sporangium) is situated at the base of the leaf and only one per leaf. This class consists of only one family, Isoetacaeae, with a single genus *Isoetes*.

  Note : Another class, Sellaginopsoda (club mosses) of this sub division has a popular terrarium plant, *Sellaginella*.

- **Subdivision Equisetophyta**
  - **Class Equisetopsida (Horsetails)**

  The leaves are vestigial and are fused to the main stem at the node. Sex organs are grouped into a cone. The cone is located at the tip of main stem or fertile stem. All species of horsetails from the family Equisetaceae belong to the genus *Equisetum*.

- **Subdivision Polipodiophyta (Ferns)**
  - **Class Polypodiopsida**

  This class comprises the true ferns. The plant families under this class representing the aquatic ferns are Azollaceae (*Azolla*), Lomariopsidaceae (*Bolbitis*), Marsileaceae (*Marsilea*), Pteridaceae *(Ceratopteris*), Polypoidaceae (*Microsorium*) and Salviniaceae (*Salvinia*). The leaves are often referred to as fronds. The submerged aquatic species have fronds which may be entire (*Microsorium*), pinnately divided (*Bolbitis* and *Ceratopteris*) or 4 lobed clover-like as in *Marsilea*. The leaves are tightly coiled in a protective covering at the early developmental stage. They bear the sporangia on the lower side of the fronds or at the base of the fronds. All these species except *Ceratopteris* have horizontal rhizomes on which the fronds develop. This class includes two genera of floating ferns, *Azolla* and *Salvinia*, which are quite popular in aquarium plant trade. Leaves of *Azolla* species are two lobed of which lower one is fertile while of *Salvinia* species are three lobed leaves of which the third submerged one is reduced to root like structures and bearing sporangia in two rows.

Division Magnoliophyta (Angiosperms)

This division includes the flowering plants with seeds enclosed in an ovary. This division is considered as the most advanced division in the plant kingdom. Majority of aquatic plants come from this division.

- **Class Magnoliopsida (Dicots)**

Embryo has two cotyledons. There are around 250 families. The following families have their representatives in the fresh water habitat.

* Acanthaceae, Amaranthaceae, Apiaceae, Asteraceae, Brassicaceae, Cabombacaceae, Ceratophyllaceae, Crassulaceae, Callitrichaceae,

Elatinaceae, Euphorbiaceae, Halograceae, Hippuridiaceae, Lentibulariaceae, Lobeliaceae, Lythraceae, Menyanthaceae, Nymphaeaceae, Onagraceae, Polygalaceae, Podostemonaceae, Primulaceae, Ranunculaceae, Saururaceae, Scrophulariaceae, and Trapaceae.

- **Class Liliopsida (Monocots)**

Embryo has only one cotyledon. The following families are of importance to the aquarists.

* Alismataceae, Amaryllidaceae, Aponogetaceae, Araceae, Butomaceae, Cyperaceae, Eriocaulaceae, Hydrocharitaceae, Iridaceae, Juncaceae, Lemnaceae, Mayacaceae, Najadaceae, Orchidaceae, Poaceae, Potomogetonaceae, Ruppiaceae, Sparganiaceae, and Typhaceae

** Please note that families are arranged in alphabetical order for easy reference instead of being in its phylogenic order.*

Algae, belonging to the group of primitive organisms are considered to be noxious weeds in the aquarium. However, *Chladophora aegagropila*, commonly called 'Moss Balls' is gaining popularity as it can grow in the form of balls without impeding the growth of other plants.

Grouping of Plants on the Basis of their Growth Habit

We have found how plants are classified scientifically in the previous section. Though it can bring some light to their position in the tree of evolution, it will give little help for the aquarists to arrange the plants in the aquarium attractively. Grouping on the basis of growth habit, though artificial, helps the aquarists to not only understand the nature of the plants, but also to achieve beautiful aquascaping.

Free Floating Plants : *Pistia, Lemna, Azolla*, etc. are free floating plants on the water surface. These plants can provide shade for those plants, which do not require high light. Though *Riccia* is a floating plant, it can be tied down on rocks or driftwood and grown fully submerged.

Stem Plants : Plants species like *Ceratophyllum, Hygrophila, Rotala,* etc. have long stem and the leaves borne by the stems are alternate, opposite or in whorls. When the plants touch the water surface, the stem may either grow along the water surface (*e.g. Ceratophyllum demersum*) as floating stems or reach out of water as in *Hygrophila* and *Rotala* species. The leaf characteristics of the submerged plants may vary when they grown as emersed. Plants belonging to this group are normally suitable for background or mid-ground positions in the aquarium. These plants are generally sold in bunches. They are usually fast growing ones and have to be trimmed very often.

Rosette Plants : These plants display the leaves in rosettes borne on a compressed stem. Majority of them have specialised organs such as bulbs, rhizome

or tuber which are partially or fully underground.

Rosette Plants with Bulb : Plants like *Crinum* develop onion like bulb, which serves as the storage organ of food for survival. The bulb has a basal plate from which roots grow and also a protective covering made of dry scales.

Rosette Plants with Rhizome : *Anubias, Nuphar* and majority of *Echinodorus,* and *Nymphaea* species have a horizontal stem called rhizome, which may be subterranean or partially buried. *Cryptocoryne* species have thin rhizomes. The rhizome has many growing points and each can give rise to individual plants.

Rosette Plants with Tubers : Some rosette plants such as *Aponogeton* species and some *Nymphaea* species develop underground tubers for the storage of nutrients. Tubers differ from bulbs by lacking a basal plate. Most of them can be specimen plants and may be planted in the centre of aquarium.

Epiphytic Plants : Plants such as *Vesicularia dubyana* (Java moss), *Bolbitis heudelotii* and *Microsorium pteropus* (Java fern) generally grow on moist tree trunks or roots (epiphytic) in its natural habitat. When we grow these plants in the aquarium, we can attach them onto a piece of driftwood.

Creeping Plants : *Glossostigma* and *Lilaeopsis* are the best examples. They have slender creeping stems with opposite or alternate leaves. The aquarists call these plants affectionately 'carpet plants' or 'lawn makers' as they soon form green cover in the foreground position. Plants such as *Echinodorus tenellus, Echinodorus latifolius, Echinodorus quadricostatus* and species of *Eleocharis* are not really creeping plants, but they produce lots of runners. Each plant looks grass-like with narrow and tapered leaves in rosettes, soon they can form a green cover in the aquarium.

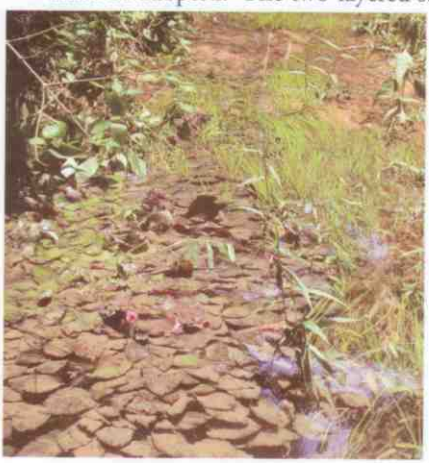
Cultivation of Aquarium Plants

Majority of the fresh water plants we cultivate today in our aquarium originate from the Tropics. These fresh water ornamentals can be divided into two types, amphibious and true aquatic. Amphibious plants can adapt to terrestrial life (emersed growth) as well as under water life (submersed growth) e.g., *Echinodorus* species and *Cryptocoryne* species. However, true aquatic plants like *Blyxa*, *Vallisneria*, etc., remain underwater for their entire life. The farms, involved in the commercial propagation of these plants exploit the dual life of amphibious plants in order to cultivate them on hydroponic troughs as emersed. This will enable the farmers to propagate them in clean environment without the threat of algae. The true aquatic plants are cultivated in tanks, remains submerged and its maintenance is not so easy as amphibious ones. Currently, well-organised farms employ modern techniques such as tissue culture to scale up the propagation of these plants in a short period of time.

The Factors to be looked into, for furnishing a Healthy Planted Aquarium.

i. Substrate

In a tank if we want to grow plants, the substrate we provide must be able to perform two important functions, i) act as a good anchoring medium for the plants; and, ii) as a constant source of nutrients for the rooted plants. In order to achieve these objectives with regard to substrate, a double-layered strategy must be adopted. The two-layered substrate has a bottom layer that is a mixture of laterite and gravel (1:3 ratio) and is almost 4-5 cm in thickness. Laterite is the end product of weathering rocks in the tropics and is red in colour due to the presence of iron oxide. This layer can act as a source of nutrients as the laterite in the mixture can keep most of the nutrients on its surface in readily available form to the plants. In other words, laterite has good cation exchange capacity. Some hobbyists successfully use garden soil as it can serve the same function of laterite. However, care should be taken while using garden soil as an additive to the bottom layer as it may be contaminated with pesticides or excess fertilisers. This may lead to the death of plants and fishes or algae outbreak. The top layer, made up of pure gravel about 0.3-0.5cm in diameter can serve as a good supporting medium for the plants. Water permeates this layer freely and carries oxygen to the roots of the plants; hence the roots can do their function, absorption of nutrients from the bottom layer normally. The gravel selected for the top layer of substrate



must be with smooth edges. If gravel with sharp edges is used, the roots will get injured while penetrating the substrate.

Substrate heating for the aquariums in the tropical region is not essential. As the temperature in this region hovers around 30°C, heating the substrate is not safe unless the aquarium is provided with a chiller or being kept in air-conditioned rooms. In temperate regions, substrate heating is essential to keep the substrate warm for the healthy growth of roots. Substrate heating brings about convection currents thereby keeping nutrients in contact with plants' root system. On the other hand, many hobbyists have been able to maintain nicely planted tanks in tropical countries without substrate heating. This has been achieved through an innovative method of controlling the temperature during summer - a small fan is fixed at the top of the aquarium and directing air currents to the water surface. As the result of water evaporation, temperature of the water goes down, keeping the temperature around 27°C.

ii. Water Chemistry

When we think of water quality, three terms should be familiarised with: Water Hardness, Alkalinity and pH.

Water Hardness: Regarding water hardness, we often hear two terms, General Hardness and Carbonate Hardness. General Hardness is contributed mainly by Magnesium ions and/or Calcium ions. General Hardness can be expressed as German Degree Hardness (GH/ °dH) or as milligramme per litre (mg/l) Calcium Carbonate ($CaCO_3$). 1 GH is equal to 17.9mg/l $CaCO_3$ or 10mg/ lCaCO (Calcium Oxide). Depending upon this, we can classify the water into:

Soft	-	4-8 GH
Medium Hard	-	8-12 GH
Fairly Hard	-	12-18 GH
Hard	-	18-30 GH

In order to achieve optimum growth, the water hardness should be maintained at 6-10 GH. If we use fairly hard water, we can still maintain a nicely planted aquarium by choosing those plants that can tolerate such degree of hardness. If the water is too hard, it should be made soft by making use of any of the water treatment processes such as de-ionisation, reverse osmosis, etc. Mix the pure water with the available water to achieve the desirable level of hardness. Carbonate hardness is directly linked with alkalinity of the water.

Alkalinity and pH: Alkalinity or Acid Fixing Capacity or Carbonate Hardness of the water is influenced mainly by the concentration of carbonate ($CO3^{--}$) or bicarbonate (HCO_3^-) ions. pH is directly linked with the concentration of Hydrogen ions (H^+) in the water. If the H^+ concentration is high, pH will be less than 7. Water with pH less than 7 is acidic, around 7 is neutral and more than 7 is alkaline. When H^+ are added in the form of acid to well-buffered water with carbonate ions, it will be fixed by the carbonate ions in the water, hence, the pH remains same. When acid is added continuously without increasing the carbonate hardness, at one stage all carbonate and bicarbonate ions

are used up to fix the H^+ and from this point onwards the pH will start dropping. Likewise, pH will go higher when carbonate hardness increases.

The buffering capacity of the carbonate hardness can be summarised by the following equation in presence of CO_2.

$$CO_2 + H_2O \Leftrightarrow H_2CO_3^- \Leftrightarrow H^+ + HCO_3^- \Leftrightarrow CO_3^{--} + 2H^+$$

When carbon dioxide (CO_2) is added into the tank the reaction shifts to right, generate more H^+ ions , and the pH drops. During photosynthesis, the plants use CO_2 hence, the reaction shifts to the left because of the consumption of H^+ ions, followed by a rise in pH. How fast the pH goes up is determined by the water alkalinity.

In a planted tank a certain level of carbonate hardness is mandatory to stabilise the pH. Carbonate Hardness can be expressed as KH or as mg/l $CaCO_3$. One KH (German degree of Carbonate Hardness) is equal to 17.9 mg/l $CaCO_3$.

Plants generally prefer mild acidic to neutral pH (6.5-7). If the carbonate hardness is low (less than 3KH) even a little addition of acid will bring about the drastic drop in pH and this will certainly affect the fish population. For a densely planted tank, additional CO_2 injection is necessary to sustain the healthy growth of plants. Some of this CO_2 will dissolve in water to form carbonic acid (free H^+ ions). A sudden drop in pH will occur, unless the carbonate hardness is maintained at about 4KH. Test kits are available in the market to measure the general hardness, carbonate hardness and pH. Please remember that all these test kits are prepared on the assumption that pH is maintained in our aquarium tanks by adjusting CO_2 concentration in accordance with carbonate hardness. If any other kind of buffer is used to stabilise the pH, these test kits may give wrong reading.

CO_2 - Table

pH \ dKH	3	3.5	4	5	6	8
6.2	56	65	75	93	112	149
6.4	35	41	47	59	71	94
6.6	22	26	30	37	45	59
6.8	14	16.4	18.7	23	28	37
7.0	8.7	10.3	11.8	14.7	17.7	24
7.2	5.6	6.5	7.5	9.3	11.2	14.9
7.4	3.5	4.1	4.7	5.9	7.1	9.4

CO_2 (mg/l)

Using this table we can decide how much CO_2 to be injected for the desired pH against carbonate hardness.

iii. Fertilisation

Plant require Carbon, Oxygen, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium and Sulphur in relatively large amount (major or macro elements) when compared to other important elements such as Iron, Manganese, Zinc, Boron, Copper and Molybdenum. Even though the second group of elements (microelements) is required in very small amounts, these elements together with macro elements are vital for growth. When any one of these elements is missing, plant growth will stagnate irrespective of the availability of the other elements.

Carbon is required by plants for food synthesis by utilising light energy. Carbon in the form of CO_2 is readily available to the terrestrial plants as the earth atmosphere has high concentration of CO_2. The concentration of CO_2 in water is very low (about 0.2mg/l in equilibrium with air), and its diffusion into the water is 10,000 times lower than into air. In a densely planted aquarium, Carbon is always the limiting factor unless it is supplemented artificially. Depending upon the carbonate hardness, CO_2 should be injected to keep the pH around 6.8. When plants synthesise food, Oxygen is released to the surroundings as a by-product. In a healthy planted tank, Oxygen is seldom deficient.

Other major elements especially Phosphorus, Calcium, Magnesium and Sulphur are normally present in all types of water source. Nitrate should be maintained at about 10 mg/l. Fish wastes and fish food are excellent sources of Nitrogen. Phosphorus is required in low amounts about 0.1-0.3 mg/l. As plants can successfully compete with algae to absorb the available Phosphorus within this range, anything more than this range can invite the threat of algae. Fish food is a good source of Phosphorus too. Potassium should be supplemented as its concentration in our drinking water is low. As Potassium does not contribute to algae growth, its concentration can be kept at a fairly high level, 15-40 mg/l. Calcium is present in all sources of water except in treated water. Calcium at 20-40 mg/l in aquarium is more than sufficient for the plants. If Mag-

nesium is low, raise it to 10-15 mg/l. Before fertilisation, do analyse the concentration of Nitrate, Potassium, Magnesium and Calcium by providing the water sample to a reputed laboratory. To adjust the Potassium and Magnesium levels, use Potassium Nitrate and Magnesium Sulphate heptahydrate (Epsom Salt) respectively. If your water contains more Nitrate use Potassium Sulphate instead of Potassium Nitrate. Add these chemicals after the water change is done. Addition of major elements should be in accordance with the amount of water changed.

For the addition of microelements, it is better to rely on commercial formulations and it is advisable to adhere to the instructions on the label. Iron concentration in the aquarium is kept at around 0.1 mg/l, because a higher dose of iron can encourage algae growth.

iv. Filtration

Is filtration really necessary for planted tanks? As plants are excellent biological filters, ammonia build up in the tank from fish wastes can be prevented. Fish excreta are a good source of nutrients for the plants. However, in a newly set up tank, the plants are yet fully functional. Moreover, the waste produced by the fish may be excessive due to the increased fish population. Under such circumstances filtration is encouraged. Another advantage of filtration is that it can facilitate water movement. Majority of aquatic plants grow in flowing water in their natural habitat. Water movement will help to keep nutrients including CO_2 in contact with leaves. An ideal filtration system will be able to facilitate both mechanical and biological filtration.

The filter should have a flow rate of 2-3 times the capacity of aquarium per hour. Mechanical filtration will keep the water free of suspended particles while biological filtration will minimise toxic waste build up in the tank. Filters with chambers filled with ceramic beads allow the denitrifying bacteria to colonise and are permanently bathed by oxygenated water. Wet and dry filter systems are not essential for planted tanks and sometimes it may be disadvantageous as it may allow CO_2 to escape.

v. Water Change

In nature, aquatic plants inhabit in open water bodies and fresh water is always added from the source through water currents. Water currents help to remove the decaying matter resulting from bacterial decomposition and also bring the required nutrients for the growth of plants. As this process is continuous, all factors for plant growth are always optimal at any given time. When we talk about planted aquarium, we must remember that it is a closed system. In the course of time, accumulation of wastes in the form of dead leaves and dead fishes or fish wastes may accumulate beyond the capacity of biological filtration. The depletion of nutrients will occur. A planted aquarium is never free of algae. Under favourable conditions, the plants can successfully compete with algae for the available nutrients in the medium, hence the proliferation of algae can be checked. When the factors are not conducive for plant growth, algae will strike back. To avoid such situation, water change is strongly advocated.

Initially, it is really advisable to change water, 1/2 of the total volume weekly, as the biological filtration is not fully established. 2-3 months after the setting up of tank, changing 1/3 of the total volume of water fortnightly is sufficient.

vi. Lighting

Choosing the right spectrum of light is always critical to promote the plant growth. Fluorescent tubes are ideal in illuminating aquariums because they generate less heat, consume low wattage in relation to lumens output and produce the right spectrum for plant growth. The following terms are helpful to choose the right source of light.

Lumens : It refers to the intensity of the light.

Lux : It is measured as lumens per sq. meter. Assume the lumens of a standard flourescent tube is 2000. When the entire amount of light is focused from such source to 1 sq. meter area, the light will be measured as 2000 lux for any spot on that area. Flourescent tubes with 2500 lumens or above should be chosen for aquarium purpose.

Colour Temperature : This is measured as Kelvin. To put it simply for instance, when a block of iron heated to melting temperature, it produces a white yellowish orange glow. The temperature at which the molten metal produces this kind of glow is the colour temperature. When the temperature reaches 5000K, the colour will be whiter, further high temperature, around 8000K, results in overly blue cast. In reality, blue light is hotter than white light. The sunlight during noontime in the equator is around 6000K and is called the cool daylight. A flourescent tube which can produce the cool daylight having colour temperature around 5500-6500K, will be ideal for illuminating a planted aquarium.

Colour Rendering Index (CRI) : The CRI of natural sunlight during noon time is 100. When an object is illuminated with a source of light having CRI 100, the object will look like what it is supposed to be. It will be in its natural colour. When CRI goes down, the colour of the object will be distorted, that means, it will not be in its natural colour. For aquarium, the light source with CRI 90 or above is to be selected.

While choosing the light source for illuminating the planted aquarium, all aforementioned factors should be taken into consideration. As a general rule, illuminate the aquarium 2-3 watts per gallon. One gallon is equivalent to 3.8 litres.

vii. Planting

Plants are to be examined for the presence of algae. Plants that are visibly contaminated with algae should be discarded. Majority of aquarium plants in nurseries are grown as emersed in small plastic pots using rockwool as substrate. If

the plants are grown on rockwool in small plastic pots, remove the pots and as much rockwool as possible. Long roots can be trimmed by using a pair of scissors. Clean the plants by rinsing them at least twice under a running tap.

Before planting the plants in the aquarium, water is to be filled to one third of the total volume of aquarium without disturbing the substrate. Using a pair of forceps or holding between your thumb and index finger insert the root zone of the plant into the substrate. After planting, drain the old water completely and fill the aquarium with new water to its capacity.

viii. Algae Control

Insofar as algae is a part of a fresh water ecosystem, its presence in the planted aquarium can be an irritant to aquarists. The total elimination of algae may be a trying task, however in its benign form, it can be tolerated. When they take an aggressive turn, immediate action should be sought.

Cause of Algae Infestation : Algae infestation is mainly due to nutrient imbalance in the aquarium, caused by either excess or low nutrients in the tank. Two elements namely Phosphorus and Nitrogen must be monitored regularly. These two elements are responsible for eutrophication (green water) in streams and rivers during autumn. Water with Nitrogen at concentrations in excess of 10 mg/l is not required for plant growth. Plants can compete successfully with algae for intake of Phosphorus, even though its level is between 0.1-0.3 mg/l. Some hobbyists are perturbed by the large proportions of algae, even when they maintain these elements at a low level. This nutrient level may not be suitable for the higher group of aquarium plants, resulting in feeble plant growth and algae blooming.

Measures to Control Algae Infestation : Before taking drastic measures to

control the algae infestation, it is advised to take note of the situation.

Minor Infestation : In this case a few plants in the aquarium are infested with black brush algae, blue green algae or green filamentous algae. The occurrence of such mild infestation is not unusual in well-established tanks. A thorough observation will reveal that this kind of algae growth is due to the over crowding of plants. When growing Java moss (*Vesicularia dubyana*) or *Riccia fluitans* on driftwood or on decorative rocks, this problem may be encountered after a period of dense growth. Fast growing plants especially stem plants like some species of *Rotala*, *Hygrophila*, etc., are subjected to algae infestation in an overcrowded aquarium. This may be due to the development of dead spots as the water circulation is affected. Introduction of algae-eating fishes and shrimps such as *Otocinclus siamensis* (Siamense algae eater), *Jordanella floridae* (American flag fish), *Cardinia japonica* (brown spotted shrimp) together with regular thinning of these plants may avoid this problem.

Whenever algae is observed to be more than its normal proportion, analysis of the elements such as Nitrogen, Phosphorus and Iron should be carried out to verify whether the outbreak is due to the nutrient imbalance. If this is not the case, the aforesaid measures shall suffice to circumvent such minor infestations.

Severe Infestations : Major infestation of algae is in the form of green water or dense growth of filamentous algae and black brush algae on each and every plant in the aquarium. This can occur in less established tanks especially in newly set up tanks. Less established plants in the tank and the low density of bacterial population for the Nitrogen cycle are the main causes for such outbreaks. If the same kind of infestation occurs in older tanks, nutrient imbalance could be the major culprit.

When there is a severe algae outbreak, the remedial action must be immediate.

CO_2 injection must be stopped. A major water change of up to 90% should be done twice a week until algae population shows signs of decline. Elemental concentrations especially Nitrogen, Phosphorus and Iron are to be monitored and checked if they are within permissible levels. It is also advised to investigate if the concentration of Potassium and Magnesium in the water are at their optimal. Please refer to the Section on Fertilisation for the corrective measures of nutrient imbalance. Fast growing plants such as *Hygrophila difformis, Hygrophila polysperma, Ceratophyllum demersum*, etc., can act as nutrient sponges. Growing such plants in the aquarium would help deprive algae of nutrients. As mentioned above, introduction of algae eating fishes and shrimps are added advantages.

ix. Aquascaping

Aquascaping or arrangement of plants requires a fair knowledge about the plants and the materials for decoration such as different types of stones and driftwood. Takashi Amano is a maestro on aquascaping and his books can provide an abundance of ideas about designing aquarium tanks. The following section will provide some basic guidelines on tank design.

Decorative Materials

When designing naturalistic aquariums, the use of driftwood and different types of stones will become indispensible.

Stones : Bazalt, granite, quartz, slate and sand stones can be safely used in aquarium decoration. However, limestones should be avoided for this purpose as it affects the water chemistry by influencing the alkalinity of water.

Driftwood : Driftwood in different shapes and sizes are available today. Driftwood collected from nature including aged roots or perforated pieces of wood from worm infestation are good examples. Before introducing them into the tank, they must be soaked in water for a few days, as this will help to remove any unwanted elements such as tannins and salt deposits.

When selecting driftwood or stone, proportionate size to the tank should be observed. Growing ferns (*Microsorium* or *Bolbitis*) or Java moss (*Vesicularia dubyana*) on driftwood will enhance the general presentation of the tank. Arrangement of rocks in the form of mounts surrounded by shorter plants can be a real eye-candy.

Plants

When arranging plants in an aquarium, they should be planted on the basis of their height and growth habit. For convenience, the tank can be divided into three sections such as background, mid-ground and foreground.

Background : Plants for background must be taller than any of the plants selected for mid-ground and foreground positions. Plants having more than 30 cm in height will be suitable for backgrounds. Most of the stem plants (*Hygrophila difformis, Hygrophila polysperma, Limnophila sessiliflora, Limnophila heterophila, Rotala indica, Rotala rotundifolia, Myriophyllum aquaticum*, etc.) as well as rosette plants with long ribbon like leaves (*Crinum thaianum, Sagittaria subulata, Vallsineria americana,* etc.) are suitable. To decorate the bogwood and rockwork in the background, use different species of *Anubias* or epiphytic plants like *Bolbitis heudelotii, Microsorium pteropus* and *Vesicularia dubyana* (Java moss), as they enhance the natural look of the aquarium.

Middle ground : In the mid-ground, select stem plants of about 15 cm or more in height, such as *Rotala macrandra, Eustralis stellata,* etc., which will introduce a warm red hue in the presence of cool green. At the centre of the aquarium, rosette plants like *Nuphar lutea, Nymphea species* (tiger lotus), *Aponogeton species* or certain *Echindorous* species like *E. amazonicus, E.* 'Ozelot', *E.* 'Rubin', *E.* 'Barthii', etc., will bring contrast in colour and shape. *Cryptocorynes* can be amassed among these plants.

Foreground : Plants which do not grow more than 10 cm in height, should be selected to decorate the foreground. Creeping plants such as *Glossostigma elatinoides* and *Lilaeopsis brasiliensis* or pigmy chain swords (*Echindorous tenellus* and *E. latifolius*) or *Riccia fluitans* (a liverwort) are ideal choices. Under thriving conditions, these plants will form a green cover in the foreground. *Riccia fluitans* is a floating plant but can be adapted to submersed growth. This plant should be secured onto rocks or driftwood by using fishing line.

Finally, plan and design the tank in advance will ensure a more pleasant and enjoyable process in setting up your dream aquarium.

Non-flowering Aquarium Plants

Algae

Majority of the plants belonging to this primitive group are rather disturbing than bringing beauty to the aquarium. A few species such as *Chlorella vulgaris*, *Chladophora aegagropila*, *Nitella flexilis* and *Rhizoclonium* speices can be safely cultivated in the aquarium. However, only very few hobbyists are making any serious attempt to integrate it into their aquascape along with other popular plants. *Chladophora aegagropila* (commonly known as 'moss balls' but do not come under the moss group) is worthy enough for a try in planted aquariums.

Chladophora aegagropila
'Moss Balls'
pH: 6.8-7.5 20-28
medium-hard
Temperate regions
A slow growing algae in the form of a ball, prefers strong light and water with high carbonate hardness (>7dKH)

Genus CHLADOPHORA
Family CHLADOPHORACEAE

The green algae balls, *C. aegagropila* are usually found in the United Kingdom, Iceland, Sweden and Japan.

This algae is velvet like and can grow up to 30 cm in diameter in the form of balls. They were once thought to be extremely slow growing; needing 150-200 years to reach the size of a tennis ball. Recent studies however suggest that the growth can be accelerated by providing more nutrients. In its natural habitat, their ability to move around by using the undercurrents to sink or rise in order to position themselves to receive plenty of light to carry out photosynthesis is interesting. In Japan, these algae balls are commonly found in lake Akan (locally called as 'Marimo'), and has been declared as "Special Japanese Natural Treasure". Research is presently underway to define the parameters in which to successfully cultivate this under aquarium conditions.

They must be kept in strongly lit areas otherwise they will start to die.

Non-flowering Aquarium Plants

Liverworts

The introduction of *Riccia fluitans* by Takashi Amano in his exuberant aquascapes as a ground cover stirred a lot of interest in this plant in the fresh water planted aquarium hobby. Even though this plant has a strong tendency to float, it can be kept submerged by tying it to a rock. Another genus, *Pellia endivifolia*, is also gaining popularity as a good aquarium plant. Both plants are thallose liverworts.

Genus PELLIA
Family PELLIACEAE

A thallose liverwort from South East Asia. In its natural habitat, the growth is restricted to moist areas.

The dichotomously branched thallus is dark green in colour, often brittle and many times bigger than that of *Riccia fluitans*. Rhizoids (root like organs) are conspicuous and arranged in a row on the lower side of the thallus.

Like *Riccia* species, it should be tied to a rock or driftwood to promote submerged growth. It prefers water with carbonate hardness (dKH) between 5-7 for its fast growth.

Pellia endiviifolia

pH: 6-7.3 22-26

soft-medium hard 1-2

S. E. Asia Thallose liverwort

Propagated from fragmentation of thallus

Genus RICCIA
Family RICCIACEAE

Riccia fluitans
WP194
pH: 5.5-7.5 20-30
soft-hard
Cosmopolitan
Thallose liverwort
Propagated by fragmentation of thallus

This genus is found widespread through out the world. There are more than 180 species belonging to this genus with some growing on wetlands, while others are amphibious or purely aquatic. *R. fluitans* is the species cultivated in aquariums. The green thallus without any distinction between stems, leaf and root is bright green in colour and dichotomously branched (fork like). Another form, dark green in colour often emerges from the thallus of the normal one is a non floating type and not so attractive. Some hobbyists claim that it is a new species, while others claim it is a mutant. Even though the normal *Riccia* has a strong tendency to float along the water surface, it can be grown submersed by attaching them to stones and woodwork in the aquarium where they soon form green carpets under favorable conditions.

Riccia species 'Dwarf'
pH: 6.2-7 23-28
soft-medium hard
Thallose liverwort
Propagated by fragmentation of thallus

This dwarf form of *Riccia* is a small thallose liverwort with rosette like habit. As it is obtained from a local aquarium shop, its origin is not known. *Riccia huebeneriana*, an endangered species in UK, also displays rosette like growth, but each rosette measures about 1.8cm in diameter. This plant can be grown with great ease in the aquarium. When it is tied to rocks, it can spread in rosettes. This rosette like habit makes this species more attractive than the normal one, *R. fluitans*.

Non-flowering Aquarium Plants

Mosses

Vesicularia dubyana is a popular aquatic moss and its maintenance is rather easy. Recently many closedly allied ones (may be different varieties of the same species) have proven to be good aquarium plants. However their proper identification is yet to be done.

Another popular species is *Fontinalis antipyretica* (Willow Moss). This species is a temperate plant and its cultivation in tropical climate is often found to be difficult.

Christmas Moss
'South America'
WP895
pH: 6-7.5 22-28 soft-hard
3 South America
Epiphytic moss
Propagated from fragmented shoots

This species can produce lateral branches in a regular fashion so as to give the appearance of Christmas tree foliage. It is often referred to as Christmas moss. This beautiful moss will enhance the natural look, if they are grown attached to rocks and wood in the aquarium.

Genus VESICULARIA
Family HYPNACEAE

Even though around 135 species in this genus only a few species can adapt to underwater life. All these species originate from the warmer parts of the world. *V. dubyana*, commonly known as Java moss, is popular among hobbyists. In its original habitat, South East Asia, it is usually found attached to fallen tree trunks and rock in humid and moist areas. The irregularly branched stems bear small emerald green leaves in two rows. They are about 2mm long. An undemanding species, which will soon form tangled masses of intensively branched stems in the aquarium after a period of acclimatisation.

Vesicularia dubyana
WP223
pH: 6-7.5 22-28
soft-hard 4
S.E.Asia
Epiphytic moss
Propagated from fragmented shoots

Vesicularia species
pH: 6-7.5 20-28
soft-hard 3
China

Epiphytic moss
Propagated from fragmented shoots

The leaves of this plant are slightly bigger than that of *Vesicularia dubyana* and its plant body is slightly broader than that of *Vesicularia dubyana*. It can easily grow on driftwood and rock in almost upright fashion.

Non-flowering Aquarium Plants

Ferns & Fern's Allies

Ferns have its representatives in the water world. Some ferns can adapt well to submerged growth while a few are floating type, such as *Azolla* and *Salvinia*. In this section, only those ferns including one of its allies (*Isoetis vellata*) that can adapt to underwater life are mentioned. The floating ones are described under the section "Floating Plants".

Bolbitis heteroclita

WP250 WP331 WO250
pH: 6-7.2 22-27
soft-medium hard 3
Tropical Asia
Epiphytic fern with rhizome
Propagated from eyes of rhizome.

Genus BOLBITIS
Family LOMARIOPSIDACEAE

Approximately 85 species are ascribed to this genus from Africa and Asia. *B. fluvitalis* and *B. heudelotii* from tropical Africa and *B. heteroclita* and *B. hydrophylla* from tropical Asia are recongised as the 4 known aquatic species.

B. heudelotii in submerged conditions develops attractive semi transparent green leaves with deeply serrated edges. A less popular species, *B. heteroclita* has tripinate leaves, which become very crinkled when grown underwater.

The creeping rhizome of this plant does not like anaerobic conditions and it should not be buried. It thrives best when attached to a stone or driftwood. They are shade loving plants and therefore should not be kept in an aquarium where they can be exposed to high light intensity.

Bolbitis heudelotii

WP056 WP667
pH: 6-7.2 22-27
soft-medium hard 3
West Africa
Epiphytic fern with rhizome
Propagated from eyes of rhizome.

Genus CERATOPTERIS
Family PTERIDACEAE

Even though only 3 or 4 species are reported, the complexity of this genus is much greater. Juvenile plants are free floating while the adult ones can either float or be rooted. *C. pteriodes* is a free floating plant bearing large oval leaves in deep water, but roots in shallow waters.

The fronds of *C. thalictroides* and *C. siliquosa* are deeply incised. *C. thalictroides* produces deep pinnate fronds only when they have grown to more than 16 cm long. For smaller plants, the fronds are more or less broader and multi-lobed.

They are hardy and are able to grow in any kind of water in the presence of strong light.

Ceratopteris siliquosa

WP771 WP808 WO771
pH: 6.5-7.5 22-30
soft-hard 3
Tropics
with deeply incised leaves
Propagated by adventitious plantlets on older leaves

Ceratopteris thalicroides

WP230 WP345
WP064 WO230
pH: 6.5-7.5 22-30
soft-hard 3
Tropics
with broader leaflets
Propagated from adventitious plantlets on leaves

Isoetes velata

pH: 6.2-6.8 20-25 soft-hard

4 Europe

Propagated from the adventitious plantlets from the base

Genus ISOETES
Family ISOETACEAE

Plants belonging to this genus are generally known as quilworts. *I. velata* from Europe has light green leaves which are slightly triangular and arranged in rosettes. The leaves are narrow with broad sheathing base and 15-30 cm long and about 0.2 cm thick. This species is ideal for mid-ground or the front corners the tank.

Marsilea angustifolia

WP1037

pH: 5.5-6.5 22-28

soft-medium hard 3

Australia Creeping plant

Propagated from the eyes of the rhizome

A delicate perennial from Australia with submerged or floating leaves. Frond stalks are up to 10 cm long with smooth leaflets. When young, the leaflets are deeply lobed rather than clover-like and about 1 cm long and 0.1 cm broad. The mature leaf is clover-like and about 1-3 cm in diameter.

Genus MARSILEA
Family MARSILEACEAE

This genus includes amphibious ferns which are almost cosmopolitan in distribution. There are about 70 species, but only a very few species can be kept in the aquarium, such as *M. crenata*, *M. drummondii*, *M. exarata*, etc. The leaves are 4 lobed; hence the common name is marsh trefoil or marsh clover.

Marsilea crenata

WP399 WP401

pH: 5.5-6.5 22-28

soft 1

S E Asia Creeping plant

Propagated from the eyes of the rhizome

M. crenata is native of South East Asia where this fern generally grows in ditches, stagnant water bodies and paddy fields. In its natural habitat, it is found with underwater rhizome bearing submerged and aerial leaves. This plant does not have floating leaves. The aerial leaves (up to 10 cm long) are 4 lobed while the submerged ones (up to 5 cm long) with 2 or 4 lobes. A very demanding plant which requires very soft water with acidic pH and cannot be kept submerged for a long time.

Marsilea quadrifolia

WP151 WP697 WO151

pH: 5.5-6.5 22-28

soft-medium hard 1

Tropics Creeping plant

Propagated from the eyes of the rhizome

M. quadrifolia is widely distributed in Asia, Europe and North America. This plant has quadripartite leaves similar to a four leaf clover. The leaves (up to 70 cm long) are arranged in two rows on creeping rhizomes. In the aquarium, the leaves will remain submerged for a short period but soon reach the surface of the water. This plant does not require bright light and can prosper in the shade.

Genus MICROSORIUM
Family POLYPODIACEAE

Microsorium pteropus
WP153 WP265
WO153 WP407
pH: 5-8 18-30
soft-hard 3
Asia Creeping plant
Propagated from the eyes of the rhizome or from the plantlets on the leaf

This genus is widely distributed in Asia, where it grows as amphibious plant attached to tree trunks or rocks. This genus includes nearly 40 species, but only one is commonly cultivated in the aquarium.

M. pteropus is popular among hobbyists as this decorative plant is hardy and can be maintained easily in any type of tanks including terrariums without the fear of being eaten by the fish. The plant has a horizontal rhizome on which the fronds (leaves) will develop upright. They are bright green, up to 25 cm long and 2-7 cm broad. The height of this plant is about 15-30 cm. A narrow leafed form, *M. pteropus* 'Narrow Leaf' has leaves which are about 8 cm long and 0.4-0.7 cm broad with a short petiole. A patented variety, *M. pteropus* 'Tropica' bred by Tropica Aps, Denmark is characterised by the presence of appendage like extensions of leaf lamina. This plant is taller (can reach 50 cm in height) and is not suitable for small to medium size tanks. *M. pteropus* 'Windelov' another patented Variety from Tropica Aps, has unique leaf morphology as the tip of the leaf blade is branched repeatedly and this peculiar branching makes them very attractive.

As mentioned above, all these plants are suited to any type of aquarium because of its flexibility with respect to temperature, water hardness and light. However, the rhizome should not be buried in the substrate instead it should be attached to rocks or driftwood.

Microsorium pteropus
'Narrow Leaf'
WP992
pH: 5-8 18-30
soft-hard
3 Creeping plant
Propagated from the eyes of the rhizome or from the plantlets on the leaf

Microsorium pteropus 'Tropica'

WP969(Driftwood)

pH: 5-8 18-30

soft-hard 3

Cultivar Creeping plant

Propagated from the eyes of the rhizome or from the plantlets on the leaf

Microsorium pteropus 'Windelov'

WP844 WP814

WO844 DWO844XS (Driftwood)

pH: 5-8 18-30

soft-hard 3

Cultivar Creeping plant

Propagated from the eyes of the rhizome or from the plantlets on the leaf

Flowering Aquarium Plants

Even though flowering plants (Angiosperms) with approximately 30,000 species form the largest group of plants, a relatively small portion of them (comprising only herbs) has adapted to marshy or aquatic life. Majority of them are terrestrial ones. They have well developed reproductive body namely flower that can bear seeds after fertilisation. The seeds are embedded in the ovary. The seed embryo of these plants has either one cotyledon (monocots) or two cotyledons (dicots). Many of these aquatic forms are cultivated for creating magnificent aquascapes.

Alternanthera reineckii
Alternanthera rosaefolia

WP011 WP620 WO011
WP010 WP406 WO010

pH: 5.8-7 22-28

soft-medium hard 3

Brazil

Propagated from cuttings

Genus ALTERNANTHERA
Family AMARANTHACEAE

A majority are found in the United States while the others in Africa and Asia. Most of them thrive in marshy areas.

Of the 170 species identified, only a few are true aquatic plants. There are considerable differences in the shape, size and colour of the leaves. *A. reineckii* has lanceolate leaves of 5-8 cm long and 0.5-1.5cm broad. *A. reineckii* var., cardinalis has undulating lanceolate leaves with width of 3-4cm. *A. reineckii* var. lilacina has leaf size similar to that of *A. reineckii* var. cardinalis, but non-undulating under submerged conditions. *A. sessilis* is characterised by its ruby red, opposite sessile leaves which are 2.5–5cm long and 0.2-1.5cm broad. The leaf colour of *Alternanthera* varies from dark red (*A. reineckii*) to olive green with pinkish violet or lilac underneath (*A. reineckii* var. lilacina).

Besides plenty of light and CO_2, *Alternantheras* need plenty of room as they tend to deteriorate if crowded.

Alternanthera reineckii
var. cardinalis

WP390 WP409 WO390

pH: 5.8-7 22-28

soft-medium hard 3

USA

Propagated from cuttings

Alternanthera reineckii var. lilacina

WP008 WO008
WP007 WO007 WP405
pH: 5.8-7 22-28
soft-medium hard 3
South America
Propagated from cuttings

Alternanthera ocipus

WO224 WP009
22-28
soft-medium hard 3
Propagated from cuttings

Alternanthera reineckii 'Variegated'

WP1036 WO1036
pH: 5.8-7 22-28
soft-medium hard 3
Cultivar
Propagated from cuttings

A. reineckii 'Variegated' has brownish red leaves with lilac streaks along the veins.

Alternanthera sessilis

WP012 WP292 WO012
pH: 5.8-7 22-28
soft-medium hard 3
Tropics
Propagated from seeds & cuttings

Most *Alternantheras* can adapt under submerged conditions except for *A. sessilis* which is essentially a terrestial plant and cannot be kept submerged for more than a few months. It can be a beautiful addition to a terrarium and paludarium where it can thrive well in semi-submerged conditions. This plant produces numerous tiny flowers in white bracts on the leaf axes. The dark maroon foliage can provide a good contrast in the background of green foliage.

Genus AMMANNIA
Family LYTHRACEAE

Ammannia gracilis

WP303 WP339
WO303 WP527
pH: 6.5-7.2 25-30
soft-medium hard 3-4
Tropical West Africa
Propagated from cuttings

Although there are not many species of *Ammannia*, their distribution is almost worldwide.

They have upright stems with opposite sessile leaves. The colour of the submersed leaves varies from olive green, (*A. gracilis*) to brick red *(A. senegalensis)*. When grown under water, the leaves are 7-12 cm long and 0.6-1.5 cm broad (*A. gracilis),* 2-6 cm long and 0.7- 1.2 cm broad *(A. senegalensis).*

Unlike the other two, *A. multiflora*, is a more difficult plant to grow under submersed conditions. The leaves of this species, borne on angular stem, that is, not round but are almost square in cross section, are 2-5 cm long and 0.3-1.2 cm broad, elliptical with blunt tips and light green in colour.

All these species do not tolerate hard water and require strong light. Pruning should be done when the stem touches the surface of the water to encourage growth of lateral branches from dormant buds. They are ideal mid to background specimens. Although most *Ammannias* prefer temperature of not more than 30 °C, *A. senegalensis* can thrive well even at temperatures up to 32 °C.

Ammannia multiflora

WP892
pH: 6.5-7.2 25-30
soft-medium hard 3-4
Asia
Propagated from cuttings

Ammannia senegalensis

WP015 WO015 WP014
pH: 6.5-7.2 25-30
soft-medium hard 3-4
Tropical West Africa
Propagated from cuttings

Genus ANUBIAS
Family ARACEAE

This genus is named after the Egyptian God ANUBIS, God of the shadows. The genus *Anubias* comprises eight species (W.Crusio, A Revision of Anubias Schott, 1979) which are endemic to West Africa. They can be found in savanna, forest areas as well as along major rivers, Zaire and Ogowe. In its natural habitat, these amphibious plants thrive best in the hot and humid areas. The height of the plant varies for different species; it may be less than 10cm as in the case of *A. barteri* var. nana or over 1m as found in *A. afzelii and A. gigantea.*

Anubias afzelii

WP523 WP676

pH: 5.5-8 22-28

soft-hard 3

Tropical West Africa

Propagated from eyes of rhizome

A. afzelii has leaf blade which is lanceolate, 13-35 cm long. Petiole is up up to 20 cm long and has a sheathing that covers more than half of the petiole. Spathe is 3-7cm long and does not spread at maturity but the tip remains open. Because of its enormous size, it is less suitable to small & medium sized aquariums.

Anubias barteri var. angustifolia

WP020 WP430 WO020

pH: 5.5-8 22-28

soft-hard 3

Tropical West Africa

Propagated from eyes of rhizome

Erroneously traded as *A. lanceolata*. Engler described *A. barteri* var. angustifolia in 1915 as *A. lancelata*, but now recognised as a variety of *A. barteri*. It has long petiole up to 32 cm long and the shape of the leaf blade is narrow oblong lanceolate to narrow oblong elliptic, 8-18 cm long and 3.5 cm broad.

***Anubias barteri* var. barteri**

WP018 WP410
WO018 WP379
pH: 5.5-8 22-28
soft-hard 3
West Africa
Propagated from eyes of rhizome

A. barteri var. barteri has leaves with long petioles (up up to 23cm long) about 1.5 times the length of the leaf blade. Shape of the leaf is oval to lanceolate, 7-16cm long and 4-11cm broad. This species has a variety of leaf shapes and characteristics. The differences in the leaf characteristics have given to the use of epithets in inverted commas to keep them as separate entities. *A. barteri* var. barteri 'Marble' has leaves characterised by the presence of white speckles on the green leaf blade, *A. barteri* var. barteri 'Variegated', the leaves are mottled with white patches and the leaves of *A. barteri* var. barteri 'Wavy' have strong undulating edges. All these cultivars are quite distinct from one another with respect to their leaf characteristics

***Anubias barteri* var. barteri 'Broad Leaf'**

WP504 WP639
WO504 WP626
pH: 5.5-8 22-28
soft-hard 3
West Africa
Propagated from eyes of rhizome

***Anubias barteri* var. barteri 'Marble'**

WP904
pH: 5.5-8 22-28
soft-hard 3
West Africa
Propagated from eyes of rhizome

Anubias barteri var. barteri
'Variegated'

WP796 WP666
WP685
pH: 5.5-8 22-28
soft-hard 3
West Africa
Propagated from eyes of rhizome

Anubias barteri var. barteri
'Wavy'

WP671
pH: 5.5-8 22-28
soft-hard 3
West Africa
Propagated from eyes of rhizome

Anubias barteri var. coffeefolia

WP1032 WP764
pH: 5.5-8 22-28
soft-hard 1-2
West Africa
Propagated from eyes of rhizome

A. barteri var. coffeefolia is a naturally occurring variety. This plant exhibits more spreading growth habit than the upright one and tends to stay under water. This growth habit makes them suitable for even small tanks. The new emerging leaf is red wine in colour and very attractive. The leaf with deeply indented veins bears some resemblance to that of coffee plant.

Anubias barteri var. nana

WP021 WP363

WO021 WP378

pH: 5.5-8 22-28

soft-hard 1-2

Cameroon

Propagated from eyes of rhizome

A. barteri var. nana is the smallest form of *Anubias*. With petiole of up to 5 cm long and glabrous leaf blade of up to 10 cm long and about 2.8cm broad. The existence of different leaf characteristics has given rise to many forms of *A. barteri* var. nana. A. *barteri* var. nana 'eye', *A. barteri* var. nana 'Marble' with leaf laminae mottled with white patches, *A. barteri* var. nana 'Narrow leaf', *A. barteri* var. nana 'Petite', *A. barteri* var. nana 'Roundleaf' with almost circular leaves, *A. barteri* var. nana 'Variegated', depicted by large white blotches on the leaf laminae and A. *barteri* var. nana 'Wrinkled leaf',with ruffled leaf blades.

Anubias barteri var. nana 'Marble'

WP905

pH: 5.5-8 22-28

soft-hard 1-2

Cultivar

Propagated from eyes of rhizome

Anubias barteri var. nana 'Narrowleaf'

WP906

pH: 5.5-8 22-28

soft-hard 1-2

Cultivar

Propagated from eyes of rhizome

Anubias barteri var. nana 'Petite'

WP898 WP936

pH: 5.5-8 22-28

soft-hard 1-2

Cultivar

Propagated from eyes of rhizome

This plant is one of the smaller forms of variety 'nana'. The dark green leaves are 1 cm to 1.5 cm long and about 0.5 cm broad. Another form 'Bonsai' *Anubias* has leaves that are as small as 0.3 cm. This feature may not be a stable one even though this plant maintains its vigorous growth by producing 'mini leaves' under adverse conditions. The good aquarium conditions can trigger normal leaf production.

Anubias barteri var. nana 'Stardust'

WP1097

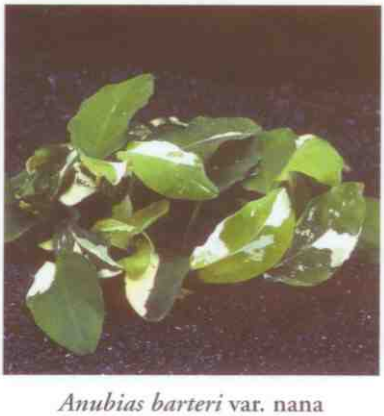
pH: 5.5-8 22-28

soft-hard 1-2

Cultivar

Propagated from eyes of rhizome

This plant is developed through induced mutation done at Oriental Aquarium in Singapore. It differs from its mother plant, *A. barteri* var. nana, by its leaf morphology. The light green leaves are about 2 cm long and 0.7 - 1 cm broad. The midrib and lateral veins are streaked with white. This plant is a rather slow growing one.



Anubias barteri var. nana 'Variegated'

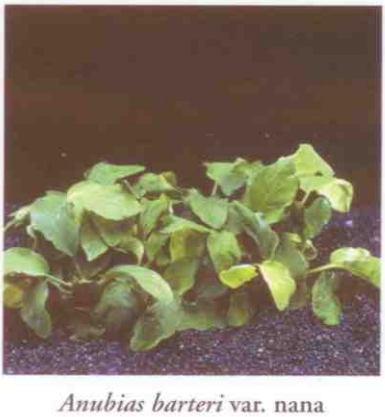
WP630

pH: 5.5-8 22-28

soft-hard 1-2

Cultivar

Propagated from eyes of rhizome



Anubias barteri var. nana 'Wrinkled Leaf'

WP602

pH: 5.5-8 22-28

soft-hard 1-2

Cultivar

Propagated from eyes of rhizome

Anubias gigantea

WP446 WP672
WO446 WP601
pH: 5.5-8 22-28
soft-hard 4-5
Tropical West Africa
with tri-lobed leaves
Propagated from the eyes of rhizome

A. gigantea is a large plant that may not be suitable for home tanks. As the leaves often grow out of the water, it is more suitable for paludariums. The leaves are trilobate. The middle lobe is ovate to lanceolate, 13-30 cm long, 5-14 cm broad and lateral lobes 9-28 cm long. The petiole is 14-60 cm long and spathe of 3.5-8 cm long. The spathe which is fleshy does not spread at maturity but the tip remains open.

Anubias gracilis

WP377 WP983 WO377
pH: 5.5-8 22-28
soft-hard 3-4
Tropical West Africa
with tri-lobed leaves
Propagated from the eyes of rhizome

Leaf lamina is triangular to cordate, 7-12 cm long and 4-10 cm broad at the base, petiole is up to 33 cm long. Peduncle is as long as the petiole. Spathe of the inflorescence is up to 3 cm long, opens when blooms and then closes again. This plant is less robust when compared to other species of this genus. Excessive handling may be detrimental to the growth of this plant.

Anubias hastifolia

WP443 WP632 WP505
pH: 5.5-8 22-28
soft-hard 4
Tropical West Africa
Propagated from the eyes of rhizome

Leaf lamina is nearly trilobed with 10-33 cm long median lobe and two smaller lateral lobes, of up to 26 cm long. Petiole is 9-67 cm long. Spathe, which is 2-4.5 cm long, does not fully open when blooms, only the upper part will open. The leaves of younger plants are lanceolate with short cordate base.

Anubias heterophylla

WP878 WP820 WO878

pH: 5.5-8 22-28

soft-hard 4

Tropical West Africa

A. heterophylla is another variable species with respect to leaf size and texture. Leaf blade is 10-38 cm long and very polymorphic in nature; can be ovate with ripplied texture or ellitical to lancelote .

Anubias heterophylla 'Lancelota'

WP019 WP280 WO019

pH: 5.5-8 22-28

soft-hard 4

Tropical West Africa

Previously erroneously traded as *A. congensis*. Petiole is 3-66 cm long. Spathe is 1.5 to 4.5 cm long opens right to the base when blooms but not reflexed. The spathe will be closed tightly around the spadix a few days after flowering.

Anubias species 'Garbon'

WP949

pH: 5.5-8 22-28

soft-hard 2

West Africa

Propagated from the eyes of rhizome

With no exact identification, this plant is most probably another form of *A. barteri* var. nana. This form has almost ellipical leaves and its blades fold upwards under emersed conditions. The shape of the leaves resembles that of a lemon plant. They are 6 - 6.5 cm long with petioles 2 - 2.5 times shorter than that of leaf blade, a typical feature of 'nana' variety.

Genus APONOGETON
Family APONOGETONACEAE

This genus is widely distributed around the world extending from tropical Asia, North East Australia and West Africa, especially the island of Madagascar. They are true aquatic with tuberous rootstock as the main reserve organ. The African species has 2-3 pronged spike inflorescence while the non African have undivided spikes. The African species will undergo dormancy while the Asian species will not.

Aponogeton boivinianus

WP022 WO022 WP023
pH: 6-7.8 16-26
soft-hard 4
Propagated from tubers
Northern Madagascar

This African species has green to brownish leaves which can grow up to 60 cm in length and 8 cm broad. The leaf lamina is indented. They are suitable as a central piece in a large aquarium.

Aponogeton capuroni

WP024 WO024 WP025
pH: 5.8-6.5 20-27
soft 4
Propagated from tubers
Southern Madagascar

This African species has ornamental leaves of up to 20 cm long and 4.5 cm broad emerging from a rhizome. The leaf lamina is crinkly and wavy. *A. capuroni* prefers soft acidic water.

Aponogeton crispus

WP026 WP266
WO026 WP027
pH: 6.5-7.3 23-28
soft-hard 4
Propagated from seeds
South East Asia

An Asian species; tends to cross breed easily with *A. elongatus, A. natans* and *A. ulvaceus*, true form of this species is seldom found. True *A. crispus* has reddish crispate leaves which can attain 40 cm long and 4 cm broad; and they do not produce floating leaves. Hybrids produce leaves with crinkled leaf edges which are translucent, light to bright green in colour. This species can tolerate hard water and is a good background to mid ground specimen for a medium sized aquariums.

Aponogeton elongatus

WP563

pH: 6.5-7.3 23-28

soft-medium 4-5

Australia

Propagated from seeds

Aponogeton madagascarensis

'Broad Leaf'

WP034 WO034 WP035

pH: 6.5-7.2 21-24

soft

3 Madagascar

Propagated from seeds and tubers

A bizzare plant because of it's leaf morphology. The leaves lack the tissue surrounding the veins and are reduced to a fine network of veins and hence the name 'Madagascar Lace Plant'. Lace like leaves are light to dark green in colour. There are two known forms, one with elliptical leaves (young leaves are reddish brown) up to 5 cm broad while the other has broader leaves (up to 8 cm broad). An extremely demanding plant which requires soft crystal clear water. Growth will be hampered with the presence of algae, suspended particles and boisterous fish. It is a good mid-ground solitary specimen plant.

Aponogeton longiplumulosus

WP507

pH: 6-7 18-26

soft 3

Propagated from seeds and tubers

North-east Madagascar

An African species with two different forms. One has slightly wavy leaves and produces pink flowers. The other has pronounced undulating leaves and produces bright purple flowers. However their leaf colour (brownish - green to bright green) and leaf size about 40 cm long and 1.5 cm broad.

Aponogeton madagascarensis
'Narrow Leaf'

WP030 W0030 WP031
pH: 6.5-7.2 21-24
soft
3
Propagated from seeds and tubers

Aponogeton rigidifolius

WP042 WP252 WO042
pH: 6.2-7.5 23-28
soft-hard 4
Sri Lanka
Propagated from seeds or eyes of rhizome

An Asian species. Unlike other *Aponogeton* species, this plant has a horizontal rhizome. The leaves (up to 60 cm long and 3 cm broad) are leathery and deep green to olive brown in colour. Leaf margin is gently wavy. This plant prefers moderately hard water. An attractive centre piece in the aquarium.

Aponogeton natans

WP040 WO040 WP041
pH: 6.5-8 24-30
soft-hard 4
Sri Lanka
Propagated from seeds and tubers

An Asian species. *A. natans* has white or bluish flowers and finding a true form of this species is rare. In nature *A. natans* crosses readily with *A. undulatus* and *A. crispus*; what we find are therefore mostly hybrids. Hybrids develop floating leaves that are elliptical with a cordate base and up to 12 cm long and up to 3 cm broad. It's submerged leaves are lanceolate, midgreen to dark green and are about 10 cm long and 1.5 cm broad. This plant is adaptable to varying water and temperature conditions.

Aponogeton ulvaceus

WP045 WP267
WO045 WP046
pH: 6.5-7.5 20-26
soft-medium soft
4 Madagascar

Propagated from seeds and tubers

This African plant has a spherical tuberous root stock of 0.5-3 cm in diameter. The bright green translucent leaves are wavy and slightly curvy. The leaf blade, 20-50 cm long and up to 8 cm broad (narrowed at the base), is attached to a long (20-30 cm) petiole. After a period of fast growth, the plant will undergo dormancy. When this occurs, the tuber should be cleared of leaves and roots and transferred to pot with sand and cold water in the dark for a period of two months. An elegant mid-ground plant for larger aquariums.

Aponogeton undulatus
Aponogeton stachysporus

WP043 WO043 WP044
pH: 6.5-7.8 22-28
soft-medium hard
3-4 India, Thailand, Burma

Propagated from adventitious plantlets on flower stalk

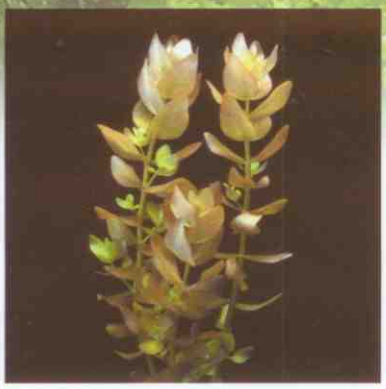
This Asian species can readily cross with other species and its true form is seldom available. The plant has a tuberous root stock, about 2.5 cm in diameter on which bears leaves with strong undulating margin. The leaf lamina (10-15 cm long and 3-5 cm broad) is green, with transparent patches. New plants often arise from the floral stalk of this plant. A hardy species which can tolerate hard water.

Genus BACOPA
Family SCROPHULARIACEAE

They are widely distributed extending from tropics to subtropics.

The lemon bacopa (*B. caroliniana*) as it is popularly known can give off lemony scent when the leaves or stem are crushed. The emergent leaves are fleshy and green with hairs underneath. When grown submersed, the leaves become translucent and attain a bronze hue under high light conditions. This plant develops blue bell shaped flowers at the axes of the leaves. Other species, *B. monniera* has wedge shaped non-hairy light green leaves, which are smaller than that of the former. They develop pinkish flowers at the leaf node. *B. myriophylloides* has needle shaped leaves in whorls, which are 0.3 - 0.6 cm long and up to 0.1 cm broad. The aerial leaves are dark green and tough textured while the submersed ones are pale green and linear.

All these species are undemanding and can thrive in any type of water and substrate. *B. monniera* can thrive well in hard to very hard water, if it can be supplied adequately with CO_2.



Bacopa caroliniana
Bacopa amplexicaulis

WP049 WO049 WP286
WP050 WO050 WP646
pH: 5-8 15-30
soft-hard 3
USA
Propagated from cuttings

Bacopa caroliniana 'Variegata'

WP748 W0748
pH: 5-8 15-30
soft-hard 3
Propagated from cuttings
Cultivar

Bacopa lanigera

WP366 WO366

pH: 5-8 15-30

soft-hard 3

South America

Propagated from cuttings

Suitable for terrariums

Bacopa monniera

WP051 WP640 WO051

pH: 5-8 15-30

medium-hard 3

Tropical Asia, America, Africa

Propagated from cuttings

Bacopa myriophylloides

WP546 WP614 WO546

pH: 5-8 15-30

soft-hard 3

South America

Propagated from cuttings

Genus BARCLAYA
Family NYMPHAEACEAE

This genus comprises only 3 species - *B. longifolia*, *B. motleyi* and *B. rotundifolia*. Of these, *B. longifolia* can adapt well to aquarium conditions. The other 2 species are often found difficult to be maintained in aquarium tanks, as they grow in acidic conditions (pH of about 4) in its natural habitat.

B. longifolia is an ornamental plant having a corm with leaves in rosette. This beautiful tropical water lily is normally found in tropical Asia, Thailand and Myanmar.

These plants flower easily under aquarium conditions. The leaves are lanceolate and can be found in two color variations. An olive green form (light green on upper surface and pink underneath) can adapt to moderate light, while the deep red form thrives best in strong light, soft water which is mildly acidic, and high temperature.

This is a fast growing plant and flowers frequently when the water temperature is sustained at 30 °C.

Barclaya longifolia

WP052 WP400
WO052 WP053
pH: 6-7 25-32
soft-medium hard
2 South East Asia

Propagated from seeds and runners

Barclaya longifolia 'Red Form'

WP311 WP311B
pH: 6-7 25-32
soft-medium hard
2 South East Asia

Propagated from seeds and runners

Genus BLYXA
Family HYDROCHARITACEAE

A demanding plant which is widely distributed in Asia.

Even though a true aquatic, it is not commonly found in an aquarium. This plant requires very consistent and stable conditions such as low carbonate hardness (2-3KH), low general hardness and the pH value of 6-7. If any conditions changed, growth will be affected and it will take a long time for it to re-establish.

The leaves are grass blades-like with tapering tips arranged in rosettes and 10-30 cm long (*B. aubertii*); or the leaves (6-8 cm long), closely arranged on ascending stems (branched) one above the other spirally in the case of *B. japonica*. The leaves are dark green, but under strong light they acquire a reddish hue. Another species, *B. alternifolia*, has long branched stems with narrow leaves (2.5 –5 cm long and 0.2 cm broad) arranged alternately.

Blyxa alternifolius

WP159 WO159
pH: 6-7 24-28
soft 4
Tropical Asia
Propagated from cuttings

Blyxa aubertii

WP1049 WO1049
pH: 6-7 24-28
soft 4
Tropical Asia
Propagated from cuttings

Blyxa japonica

WP055 WO055
pH: 6-7 24-28
soft 3
Tropical Asia
Propagated from cuttings

Cabomba aquatica

WP058 WO058

pH: 6-7 18-26

soft-medium hard 5

Central America

Propagated from cuttings

Genus CABOMBA
Family CABOMBACEAE

These plants are mostly found in South and North America.

C. aquatica (yellow cabomba), *C. caroliniana* (green cabomba) and *C. piauhyensis* (red cabomba) are popular among hobbyists. The leaves of *C. aquatica* are pinnate (about 500 segments per leaf) and finer when compared to *C. caroliniana* (about 200 segments per leaf). These two species produce only two leaves from each node while *C. piauhyensis* develops three leaves from every node. *C. caroliniana* can be easily grown in a variety of conditions. It also tolerates hard water. The other two species are demanding and require soft water as well as a substrate rich in nutrients. Flowers are yellow (*C. aquatica*), white (*C. caroliniana*) or purple red to violet (*C. juscata*). A newer discovery, *C. palaeformis* has green to light brown pinnate leaves (40-90 segments per leaf).

Cabomba caroliniana

WP057 WP384 WO057

pH: 6-7 18-26

soft-medium hard 5

Central America

Propagated from cuttings

Cabomba juscata
Cabomba piauhyensis

WP059 WP474 WO059

pH: 6-7 18-26

soft-medium hard 5

South America

Propagated from cuttings

Cabomba palaeformis

WP1046 WO1046
pH: 6-7 18-26
soft-medium hard 5
Central America
Propagated from cuttings

Genus CARDAMINE
Family BRASSICACEAE

A swamp plant found in subtropical Asia.

The bright green leaves are bean shaped with gently serrated margins.

It prefers low temperature (15-22 °C). This decorative plant requires plenty of light and water with moderate hardness. It will exhibit weak growth (producing thin stems and smaller leaves) in poor lighting and high temperature. The trailing growth habit of this plant is very attractive in any aquarium.

Cardamine lyrata

WP063 WP665 WO063
pH: 6-7 15-22
soft-medium hard 4
Subtropical Asia
Creeping plant
Propagated from cuttings

Genus CERATOPHYLLUM
Family CERATOPHYLLACEAE

These aquatic perennials generally known as hornworts or coontails are widely distributed around the world. There are about 10 known species of this genus; two of which are commonly found in aquariums.

They are floating plants sometimes anchored by fragile root like organs (rhizoid). The light green to yellowish bristle like foliage are arranged in whorls and are quite fragile and cannot withstand pressure. The distinctly toothed leaves are bifurcated with 4 tips (*C. demersum*) or with 2 tips (*C. demersum* 'Mexico'). In addition, the Mexican variety has light red stem.

These plants can survive in a wide variety of environment, from temperate Europe to warm Mediterranean regions. Under favorable conditions, these plants branch quickly and form a thicket on the surface providing a hiding place for fry. These plants are suitable for cold or temperate aquariums. As they are fast growers, they can act as biological filters for excess nutrients. They can tolerate hard water.

Ceratophyllum demersum
WP323 WO323
pH: 6.5-7.5 15-28
soft-hard 3
Cosmopolitan
with floating stems
Useful plant in battle against algae
Propagated from cuttings

Ceratophyllum demersum 'Mexico'
WP745 WO745
pH: 6.5-7.5 15-28
soft-hard 3
Mexico
Propagated from cuttings

Genus CRASSULA
Family CRASSULACEAE

The genus *Crassula* comprises mostly succulent terrestrial forms distributed in the tropics. However, *C. helmsii*, an aquatic form is a native to Australia and New Zealand.

This aquatic perennial can grow bushy and has stems (5-10 cm long and 1-2mm thick) with many branches bearing opposite bulbous leaves (up to 1.5 cm long and 0.5-1mm broad).

This plant is ideal for foreground to middle ground in bunches.

Crassula helmsii

WP509 WP499

pH: 6.8-7.2 17-25

soft-medium hard 1

Australia / New Zealand

with bulbous leaves

Propagated from cuttings

Crinum calamistratum

WP518

pH: 6.8-7.5 24-28

soft-hard 3

Cameroon

Propagated from bulblets

Adapts well to brackish water conditions

1/3 of the bulb should be above the substrate

Genus CRINUM

Family AMARYLLIDACEAE

This genus is a native to tropical and sub tropical Asia, Africa and South America with more than a hundred species reported.

They have onion like bulbs which serve as storage organs. Some species are true aquatic while other, such as *C. purpurascens* prefers paludarium conditions, *C. augustifolium* prefers brackish water and can be found growing among mangroves. The leaves of these plants are tough and fibrous and non -palatable to fish.

C. calamistratum has narrow and crinkled leaves which can reach 70-100 cm long and 0.2-0.7 cm broad. *C. natans* produces leaves with undulating edges of up to 140 cm long and 2-5 cm broad. This species has attractive white flower which will bloom above the water surface. *C. natans* 'Crispus' has very crispate leaves that are 50-70 cm long and about 1 cm broad. The leaves of *C. thaianum* are smooth strap like and can be up to 3 m long and 1.5 –3 cm broad.

All *Crinum* species are hardy and can grow in any type of water. However, they are not fast growers. As they produce very long leaves, they are not recommended for small aquariums. They make excellent mid-background plants.

Crinum natans

WP067 WP068

pH: 6.8-7.5 24-28

soft-hard 5

Tropical West Africa

Propagated from bulblets

Adapts well to brackish water conditions

1/3 of the bulb should be above the substrate

Crinum natans 'Crispus'

WP519

pH: 6.8-7.5 24-28

soft-hard 3

Cameroon

Propagated from bulblets

Adapts well to brackish water conditions

1/3 of the bulb should be above the substrate

Crinum thaianum

WP069 WO069 WP070

pH: 6.8-7.5 24-28

soft-hard 5

Thailand

Propagated from bulblets

Not suitable for small to medium sized tanks

Adapts well to brackish water conditions

1/3 of the bulb should be above the substrate

Genus CRYPTOCORYNE
Family ARACEAE

The genus *Cryptocoryne* comprises more than sixty species. They can be found in tropical countries such as India, Indonesia, Malaysia, New Guinea, Philippines and Sri Lanka. They can be found in slow or fast flowing streams and in small water bodies formed near the streams in wet seasons.

Most of the species are amphibious while a few are truly aquatic, one such example is *C. aponogetifolia*. Almost all *Cryptocoryne* species are prone to the infamous 'Cryptocoryne Rot' whereby the leaves disintegrate due to transplant shock, changes in the water chemistry or light intensity, etc. *C. crispatula* var. balansae is an exception to this as it is quite resistant to this leaf disintergation.

Cryptocoryne affinis
Cryptocoryne haerteliana

WP071 WO071
pH: 6.5-7 20-28
soft-hard 2
Malaysia Propagated from runners
Grows better in water
with hard carbonate context

In its natural habitat, they grow on calcareous soil in fast flowing streams. The leaves are emerald green with carmine to purplish on the underside. This plant, can tolerate hard water and it is one of the hardiest species as it can tolerate low temperature for a short period.

Cryptocoryne albida

WP296 WP600 WO296
pH: 6.5-7 20-28
soft-hard 2
South East Asia
Propagated from runners
Suitable for terrariums

C. albida grows in shallow fast flowing streams in its natural habitat. They thrive best when water level in the stream is low, hence this plant is more suited to terrariums. Their leaves are elliptical with wavy margins and are light green to reddish brown in colour.

Cryptocoryne becketii

WP075 WP678 WO075
pH: 6.8-7.5 24-28
medium hard-hard 2
Sri Lanka Very hardy
Propagated from runners

Cryptocoryne becketii is hardy and can be found in Sri Lanka. It prefers medium hard water. It has leaves that are 10-20 cm long and 2-4 cm broad which are olive green to brown with purple to reddish underside. This is one of the few *Cryptocoryne* species which can give an effective contrast to other plants in the aquarium.

Cryptocoryne ciliata

WP079 WP686 WO079

pH: 6.8-7.8 24-28

medium hard-hard 3

Thailand, Malaysia

Propagated from aerial runners

Adapts well to brackish water conditions

A very common species found throughout Asia, from India to New Guinea. This species is characterised by the presence of cilia or fine hair on the outer edges of the spathe of spadix inflorescence. There are two forms, narrow leafed and broad leafed which are lanceolate in shape with wavy margins. This species produces above ground runners unlike other species where underground runners are being produced. In its habitat, they can be found growing in brackish waters, hence, it easily adapts to hard water conditions.

Cryptocoryne cordata 'Rosa Nervis'

pH: 6.5-7.5 24-26

soft-hard 4

Cultivar

Propagated from runners

C. cordata "Rosa Nervis", is believed to be a cultivar. This plant has pink veins on the glossy dark green leaf blade. This feature may be less pronounced under certain conditions. All these species are characterised by broad yellow limb of spathe, which maybe glossy (*C. cordata* var. siamensis) or with a brown tinge in the case of *C. cordata* var. blassii.

Cryptocoryne cordata var. blassii

WP076 WP317 WO076

pH: 6.5-7.5 24-26

soft-hard 4

Thailand, Malaysia

Propagated from runners

This species is native to Thailand and Malaysia. The normal form of *C. cordata* has cordate green leaves. *C. cordata* var. siamensis has oval shape leaf lamina which is brown on the upper side and purplish on the underside. *C. cordata* var. blassii, has narrow oval leaves with pale red veins which is either puckered or smooth. The leaf colour is brownish green and deep purple on the underside. *C. cordata* var. blassii is one of the common species found in aquariums where it can grow up to 20 cm tall and tolerant to hard water.

Cryptocoryne cordata var. siamensis

WP080 WP254 WO080

pH: 6.5-7.5 24-26

soft-hard 4

Thailand

Propagated from runners

Cryptocoryne crispulata
Cryptocoryne retrospiralis

WP092 WP606 WO092

pH: 6.8-7.2 20-26

soft-medium hard 3

India, Thailand, China

Propagated from runners

A native of India, Thailand and China. This plant grows from its thick root stalk. The leaves (15-30 cm long and 1-1.5 cm broad) are narrow and lanceolate with sheathed petiole. The leaf lamina is gently crispate and dark green with wavy margins. They will turn light brown when the light is strong. The spathe is narrow and long (11-12 cm) and the upper part is spirally rolled up. It can be kept in the middle or on the sides of the tank under strong light. When transplanted, they drop its leaves and will take some time to establish again.

Cryptocoryne crispatula var. balansae

WP074 WP404 WO074

pH: 6-8 20-28

soft-very hard 3

South East Asia

Propagated from runners

Less susceptible to cryptocoryne rot

Cryptocoryne crispatula var. balansae, native to Thailand, is mostly found in medium to fast flowing rivers having a high calcium content. A very elegant plant which can reach up to 40 cm tall in the aquarium. The tapering leaves, usually green in colour acquire brown tones under high light, are 10-50 cm long and 2-4 cm broad with a very wrinkled leaf laminae. This plant is suitable for background decoration, but requires a tank with a minimum depth of 45 cm.

Cryptocoryne griffithii

WP081 WO081

pH: 5.0-6.9 22-25

soft 3

Malaysia

Propagated from runners

This species is distributed in Peninsular Malaysia and is generally considered to be one of the most difficult species to be cultivated under aquarium conditions. Elliptical or egg shaped leaves with blunt tips which can reach 7 cm long and 5 cm broad. The leaf lamina is dark green to brown on the upperside and purple on the underside. They develop brown spots on upper surface if the plant is placed under direct light. The spathe of the inflorescence has a trumpet shaped limb, deep red in colour with small protuberances. This plant requires soft and acidic water.

Cryptocoryne lingua

WP083 WP683 WO083

pH: 6.5-6.9 20-25

soft 2

Malaysia, Borneo

Propagated from runners

This species is native to Malaysia and Borneo and can easily be identified by its spoon shaped green leaves. An extremely difficult species as many hobbyists claim that this plant will not survive for more than a month in an aquarium.

Cryptocoryne longicauda
Cryptocoryne johorensis

WP084 WP999

pH: 6.5-6.9 22-28

soft 3

Malaysia, Borneo

Propagated from runners

Located in Peninsular Malaysia and Indonesia. Leaves are egg shaped and slightly bullate with characteristic membranous margin; a unique feature to this species. The spathe of the inflorescence has a deep red limb with a unique long tail up to 20 cm long. *C. johorensis* is now regarded as the synonym of this species. This species is difficult to keep in the aquarium for a lengthy period.

Cryptocoryne lucens

WP085 WP494
WO085 WP689
pH: 6.5-8 24-28
soft-medium hard 2
Sri Lanka
Propagated from runners

A Sri Lankan perennial which grows amphibiously in nature. The leaves are deep green, leathery and thick. The egg shaped leaf blade is longer than the petiole with a wedge shaped base. This hardy species can be planted in foreground and can form thick tufts.

Cryptocoryne lutea

WP442 WP491
WO442 WP687
pH: 6.5-7 20-25
soft-hard 2
Sri Lanka
Propagated from runners

A native to Sri Lanka growing in swamps and even in brackish water. The leaves are oval with blunt tips and green when grown as emerse plants. Leaf blade is characterised by the presence of 2-3 parallel veins with cross veins on both sides of the midrib. Like *C. lucens* they are suitable for foreground planting.

Cryptocoryne parva

WP087 WP408 WO087
pH: 5.5-6.8 22-28
soft-hard 1
Sri Lanka
Propagated from runners

The smallest known species of Cryptocoryne originating from Sri Lanka. The leaves are grass-like not exceeding 6 cm long. A slow growing plant requiring plenty of light and takes a relatively long period (5-6 months) to give a turf like appearance. A nice foreground plant in groups.

Cryptocoryne petchii

WP089 WP476
WO089 WP688
pH: 6.5-7.5 22-28
soft-hard 2
Sri Lanka
Propagated from runners

This plant from Sri Lanka is a triploid form of *C. beckettii*. These leaves are characterised by fine undulating margins with transverse stripes. Like *C. beckettii*, the limb of the spathe is brownish yellow with a brown collar. This plant can be easily maintained in any type of water.

Cryptocoryne pontederiifolia

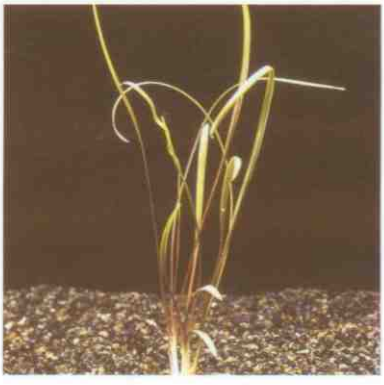
WP090 WP611
WP091 WP473 WO091
pH: 5.5-8 18-29
soft-hard 2
Sumatra
Propagated from runners
Not suitable for small tanks

This species is endemic to Sumatra. The egg-shaped leaves with pointed tips are 9-14 cm long and 3-8 cm broad. The leaf blade is puckered and olive green on upper side and light pink underneath. The spathe of spadix inflorescence is wide open when compared to that of other species and can reach 10 cm in length. This plant can be easily maintained in an aquarium and is suitable in the mid-ground of the tank.

Cryptocoryne pygmaea

WP1131
pH: 6.8-7.2 20-28
soft-hard 1-2
Philippines
Propagated from runners

This species from Palawan in the Philippines was only recently introduced to the hobbyists. In its natural habitat it can reach 25cm in height. The narrow lanceolate leaves. brownish green with a reddish hue on the underside are fleshy when grown emersed. The spathe of the spadix inflorescence is 3-4cm long with a limb having reddish rough inner surface. The collar is generally absent. A demanding plant. hence cultivation is difficult.



Cryptocoryne tonkinensis

WP506 WO506
pH: 6.5-7.8 22-28
soft-hard 2
India, Indo-China
Propagated from runners

This species is usually found in India and China. In its natural habitat it can reach 40 cm in height. The olive green leaves are narrow (0.2-1cm broad) and up to 40 cm long. There is no distinct demarkation between leaf petiole and leaf blade. This plant adapts to being grown submersed quickly. As they have narrow leaves, planting in groups in the mid-position or in the front corners of the tank will give the aquarium a natural look.

Cryptocoryne undulata 'Red'

WP675 WP690
pH: 5.5-8 20-28
soft-hard 2
Sri Lanka
Propagated from runners

This plant originates from Sri Lanka and there are two forms available, diploid and triploid. The lanceolate leaves have long petiole with reddish veins on the lower side of the leaf lamina. The wavy nature of the leaf is not stable in triploid form. The spathe has a twisted limb with a distinct collar. This plant grown in groups is very attractive in the foreground.

Cryptocoryne walkeri

WP095 WP682
WO095 WP691
pH: 6-7.5 22-30
soft-medium hard 2
Sri Lanka
Propagated from runners

A Sri Lankan species closely allied to *C. lutea*. *C. lutea* is considered as another 'form' of *C. walkeri* and has separate descriptions. The leaves of *C. walkeri* have long petioles that are bronze green on upper side and purplish underneath. These plants are to be planted a few cm apart in the aquarium in foreground settings.

Cryptocoryne usteriana

WP1087
pH: 6.8-7.2 20-28
soft-hard 4-5
Philippines
Propagated from runners

Previously this name was thought to be the synonym of *C. aponogetifolia*. However, the rediscovery of C. *usteriana* cleared the confusion. This plant is a native of Philippines. Elliptical leaves arise from a short stem have wrinkly leaf blades. They are green on the upper side and purple underneath. *C. aponogetifolia* clearly lacks the purple colour on the lower side of the leaves. The spathe of the spadix inflorescence has a broad limb. This plant is really attractive when planted in groups in middle to back ground.

WP675

Cryptocoryne wendtii 'Broad Leaf'

WP493

pH: 5.5-8 20-28

soft-hard 2

Sri Lanka

Propagated from runners

A polymorphous species found in Sri Lanka. Depending on the leaf characteristics, this species is divided into many 'forms'. Such as *C. wendtii* 'Broad Leaf' (leaves are broader and longer than *C. wendtii* 'Green'), *C. wendtii* 'Brown', *C. wendtii* 'Green' (green leaves with brown streaks on the upper side), *C. wendtii* 'Green' x Tall Form (most probably a natural hybrid having egg shaped leaves with reddish brown veins on the lower side), *C. wendtii* 'Mi Oya' (leaves are gently bullate with non-serrated margins, collected from Mi Oya in Sri Lanka), *C.wendtii* 'Tropica' (dark brown leaves which are strongly bullate with dentate margins), etc. The spathe of the spadix inflorescence has a twisted limb with deep purple collar on the inner part. This is a feature common to all these species. *C. wendtii* is tolerant to hard water and is suitable as foreground plant in the aquarium tank.

Cryptocoryne wendtii 'Brown'

WP681

pH: 5.5-8 20-28

soft-hard 2

Sri Lanka

Propagated from runners

Cryptocoryne wendtii 'Chameleon'

WP1094

pH: 5.5-8 20-28

soft-hard 2

Cultivar

Propagated from runners

This new variety is a cultivar obtained through mutation breeding at Oriental Aquarium, Singapore. The pattern of variegation is not uniform. Majority of the leaves are depicted with creamy or brown patches along the leaf blade. Some leaves develop shades of red along the creamy patches of leaf blade. If the plant maintains this type of variegation, it becomes quite attractive and unique. Planting singly or in groups of 3 in the middle ground of the aquarium is really an eye catcher.

Cryptocoryne wendtii
'Green Gecko'
WP1095
pH: 5.5-8 20-28
soft-hard 2
Cultivar
Propagated from runners

Another cultivar developed at Oriental Aquarium, Singapore, through mutation breeding. The newly emerging leaves are yellowish-green with brown streaks along the midrib. Later these leaves attain light green in colour. The yellowish-green or light green leaves can produce attractive contrast in the presence of dark green plants in the middle ground of the aquarium.

Cryptocoryne wendtii 'Green'
WP097 WP807 WO097
WP489 WP804
pH: 5.5-8 20-28
soft-hard 2
Sri Lanka
Propagated from runners

Cryptocoryne wendtii
'Green' x Tall Form
WP674 WP802
pH: 5.5-8 20-28
soft-hard 2
Sri Lanka
Propagated from runners

Cryptocoryne wendtii 'Mi Oya'

WP478 WP692
pH: 5.5-8 20-28
soft-hard 2
Sri Lanka
Propagated from runners

Cryptocoryne wendtii 'Tropica'

WP629 WP803
pH: 5.5-8 20-28
soft-hard 2
Sri Lanka
Propagated from runners

Cryptocoryne wendtii x hybrid

WP679 WP693
pH: 5.5-8 20-28
soft-hard 2
Sri Lanka
Propagated from runners

Cryptocoryne x willisii

WP680 WP805
pH: 6.5-7.2 22-30
soft-hard 2
Sri Lanka
Propagated from runners

A native of Sri Lanka and it is considered as a natural hybrid. The leaves (2-5 cm long and 0.6-1 cm broad) have long sheathed petiole and lanceolate leaf lamina with round or wedge shaped base. The leaf colour is olive green. This hardy species can tolerate hard water and high temperature. An elegant plant which can be kept in the foreground.

Cyperus helferi

WP1082 WP767 WO1082

pH: 5-7.5 20-30

soft-medium hard 3

Tropical Asia

Propagated from seeds

Slow growing

Genus CYPERUS
Family CYPERACEAE

The genus *Cyperus* contains many species, most of them are marsh dwelling and prefer brackish water, e.g. *C. papyrus*.

C. helferi, wide spread in tropical Asia, is an amphibious plant which can also flourish in the aquarium. The long bright green grass like leaves can reach 60 cm long and 0.9 cm broad.

This plant requires plenty of light and CO_2 injection.

Didiplis diandra
Peplis diandra

WP191 WP819 WO191

pH: 5.8-7.2 22-28

soft-hard 2

North America

Propagated from cuttings

Genus DIDIPLIS
Family LYTHRACEAE

Didiplis diandra (*syn: Peplis diandra*) is a native of North America.

This plant has needle shaped opposing leaves on multi branched stem. The leaves are 5-10 cm long and 0.1 to 0.15 cm broad. They are light green and will turn pink when they are closer to the light source.

They are ideal foreground plants and can tolerate wide range of light and water conditions.

Genus ECHINODORUS
Family ALISMATACEAE

The genus *Echinodorus* comprises more than 30 species that are collected from its original habitat (South and Central America) and also some cultivars like *E.* 'Ozelot', *E.* 'Rubin', *E.* 'Oriental', etc, obtained either by artificial hybridisation or by spontaneous mutation.

All these plants produce leaves in basal rosettes. A majority of the species are amphibious and can adapt to aquarium conditions. However, *E. argentinensis* and *E. grandiflorus* are not suitable for planted aquariums as they do not produce submerged leaves. A variable genus as the plants differ from one another in height and shape of leaves. Root feeding can promote growth in the aquarium.

Echinodorus amazonicus

WP107 WP106
WP638 WO107
pH: 6-7.2 22-26
soft-medium hard 4
S. America
Propagated from adventitious plantlets on the floral stalk

This species, distributed in Lower Amazon, Brazil, is one of the more popular aquarium species. The leaves are lanceolate with pointed tips which can attain 40 cm in length and 1.5-3 cm in breadth. It is a beautiful central piece which requires medium to strong illumination. The flower stalk of this plant produces plantlets.

Echinodorus angustifolius

WP1127
pH: 5.8-7.2 20-28
soft- hard 4
S. America
Propagated from runners

Rataj reported this plant in 1975 from the state Mato Grosso of Brazil. A rosette plant bears very linearly lanceolate leaves with long pointed tips. Leaves are about 40cm long and 0.5cm broad and pale green. Only the midrib of the leaf is very conspicuous and the lateral veins are very diffused. These leaf characters will mislead the hobbyists to identify it wrongly as long and narrow leafed *Vallisnerias*. However proper identification can be done with the help of inflorescence from emergent plants.

Echinodorus 'Apart'

WP464 WP673
836 WP940 WP961
pH: 6-7.5 22-28
soft-hard 3
Cultivar

Propagated from the eyes of rhizome

A hybrid (*E.* x barthii x *E. portagalensis*) developed by H. Barth (Dessau, Germany). This plant is characterised by its aerial circular leaves (about 35 cm long and about 6.5 cm broad) with long petioles (up to 25 cm long). They are brownish green with glossy leaf blades. When grown submerged it produces elliptical leaves (about 13 cm long) that are gently wavy with short petioles. A good mid-ground specimen for medium to large tanks.

Echinodorus argentinensis

WP553 WP660
WO553 WP641
pH: 6-8 16-28
soft-hard 5
Brazil

Propagated from the adventitious plantlets on the floral stalk or from seeds
Suitable for terrariums

E. argentinensis is closely allied to *E. grandiflorus*. It can grow up to 4m long in its natural habitat. The leaves can grow up to 2.5m tall. The leaf blade, which is broadly lanceolate with pointed tip and cordate base has characteristic pellucid (membranous) lines. This plant never produces permanently submersed leaves. This species can easily cross with *E. grandiflorus* or *E. longiscapus* and hybrids with various characters can be produced. A good candidate for temperate ponds as it can tolerate low temperature.

Echinodorus x barthii

WP388 WP470 WO388
WP631 WP447 WP471
WP967

pH: 6-9 18-26

soft-hard 3

Cultivar

Requires nutrient rich bottom, otherwise less demanding,
Propagated from the adventitious plantlets on the floral stalk

This plant is a hybrid. Young submerged leaves are dark red and turn green when matures. The leaves can reach 14 cm long and 4 cm broad in aquarium conditions. The leaf lamina folds backwards. This plant requires plenty of light together with CO_2 injection. An elegant plant, ideal for the middle of the tank. It can adapt to a wide range of conditions.

Echinodorus berteroi

WP840

pH: 6.8-7 20-27

soft-medium hard 3

S. America

Propagated from seeds

This species develops three types of leaves on the same plant; submerged ribbon shaped ones, another type of submerged leaf that is about 25 cm long with the leaf blade being semi cordate or round based and finally floating leaves which are elliptical and lobular at the base of the leaf blade. A beautiful plant when it is in its first or second stage of leaves with no large floating leaves. An ideal mid-ground plant, suitable for larger aquariums.

Echinodorus bleheri

WP109 WP233 W0109
WP653 WP108 WP325
WO108 WP644
pH: 5.5-9 20-30
soft-hard 3-5
South America
Propagated from the adventitious plantlets on the floral stalk

One of the most widely used plants in aquarium because of the ease in maintenance. The leaves, dark green to lime green (*E. bleheri* 'Azurea') are elliptical with tapering ends. An undemanding plant that can survive in a wide range of conditions. This plant has to be trimmed regularly so as not to deprive the other plants growing underneath of light.

Echinodorus bleheri 'Azurea'

WP951
pH: 5.5-9 20-30
soft-hard 3
Cultivar
Propagated from the adventitious plantlets on the floral stalk

Echinodorus cordifolius

WP534 WP482
WO534 WP810
pH: 6.5-7.5 18-28
soft-hard 4
S. America
Propagated from the adventitious plantlets on the floral stalk

This plant was previously known as *E. radicans*, a name now considered obsolete. Young leaves are usually oval and become heart-shaped as they mature. The petiole is shorter or equal to the length of leaf blade when grown submersed. The leaf blade has 4 conspicuous lateral veins on both sides of the mid rib and is lobed at the base. A hardy species that requires plenty of room, light and a good substrate. It is able to grow up to 60 cm in height in the aquarium while in terrariums it can reach 150 cm.

Echinodorus cordifolius
'Marble Queen'

WP448 WP603 WP812
pH: 6-8 22-28
soft-hard 3
Cultivar

Propagated from the adventitious plantlets on the floral stalk

This plant is obtained as a result of natural hybridisation or as a variant due to spontaneous mutation in Oriental Aquarium, Singapore. The oval or heart shaped leaves are medium green mottled with creamy or yellow patches. This beautiful variegation may fade when the plant is grown submerged. This plant will be a beautiful addition to terrariums in which they can produce variegated leaves continuously under strong light.

Echinodorus grandiflorus

WP552 WP431
WO552 WP650
pH: 6-8 18-28
soft-hard 5
S. America

Propagated from the adventitious plantlets on the floral stalk

A hardy plant which can reach up to 4 m tall in its natural habitat. The leaves can attain a length of 1.5-2.5 m and have long petioles; heart shaped with circular base and blunt tip. Like *E. argentinensis*, the leaf blade has characteristic pellucid (membranous) dots/lines. It is the largest species of this genus and it cannot produce submersed leaves. This species crosses easily with *E. grandifolius* or *E. longiscapus* and hybrids with varied characters can be produced. These plants can tolerate low temperature and can be planted in ponds in temperate region.

Echinodorus horemanii 'Red'

WP467 WO467
WP651 0 WP477
pH: 6.5-7.2 18-25
soft 4
Brazil

Propagated from the adventitious plantlets on the floral stalk

One of the more beautiful plants belonging to this genus now available in two forms; *E. horemanii* 'Green' and *E. horemanii* 'Red', based on the leaf colour. The leaves are 30-50 cm long borne on short petioles. They are dark olive green (*E. horemanii* 'Green') to deep red *(E. horemanii* 'Red') with glossy leaf lamina. There are two pairs of lateral veins, the outer pair curves away from the mid rib at leaf base and soon reaches the margin while the inner pair runs very close and parallel to the midrib almost one fourth from the base and curves away. This plant requires relatively cool temperature and very clear water. A decorative centre piece plant.

Echinodorus 'Indian Red'

WP1035 WP1034 WP985
pH: 6-7 22-27
soft-medium hard 3
Cultivar

Propagated from the adventitious plantlets on the floral stalk

Another hybrid (*E. aschersomarius* x *E. horemanii* 'Red') developed by Mr. H.Barth of Germany. The leaves are broadly lanceolate and sometimes narrowly lanceolate. The young leaves are deep red in colour. However, the leaf lamina is wavy and slightly curved, and not folded backwards like that of *Echinodorus* x. 'Barthii' under submerged conditions. A beautiful centre piece, which can provide a good contrast in the background of green plants.

Echinodorus latifolius
Echinodorus xingu

WP104 WP522 WP610
WO104 WO522
pH: 7-8 20-27
medium hard 2
Central America
Propagated from runners

A hardy species which can produce runners. The leaves in rosettes can reach 20 cm long and 0.9 cm broad. Leaf blade is narrowly lanceolate and erect. *E. latifolius* resembles *E. quadricostatus*, but the latter has shorter and broader leaves. This plant can be planted in the middle in bunches or in the front corners of the aquarium.

Echinodorus major

WP105 WP257 WP647
WO105 WP972
pH: 6.5-7.2 20-25
soft-medium hard 4
Brazil
Propagated from the adventitious plantlets on the floral stalk or from seeds

This plant is popularly known as *E. martii* among the hobbyists. It has a strong rhizome which bears light green and wavy leaves. The leaves are 30-50 cm long and 2.5-7.5 cm broad. The petioles are shorter than the leaf laminae. There may be 2-3 pairs of lateral veins on the leaf lamina, depending upon the leaf size. The outer pair curves and soon reaches the margin while the rest deflects from the lowest quarter or from the middle of the leaf lamina. A solitary specimen, ideal in the middle of the tank.

Echinodorus macrophyllus

WP113 WP234
WO113 WP645
pH: 5-8 18-28
soft-hard 5
S. America
Propagated from the adventitious plantlets on the floral stalk

The aerial leaves are up to 120 cm long with leaf blades that are triangularly cordate. The leaf blades are 30-40 cm long having almost same width. Submerse plants have shorter leaves (30-40 cm long) with dark green blades (sometimes red spotted with wavy margins). They lack pellucid lines/dots. To prevent it from growing out of the aquarium it has to be cultivated in a nutrient poor substrate under moderate lighting in aquariums.

Echinodorus muricatus 'Green'

WP668 WP811
pH: 5.5-7.5 22-26
soft-medium 3
Cultivar
Propagated from the adventitious plantlets on the floral stalk

Echinodorus 'Oriental'

WP654 WP966
WP698 WP965
pH: 5.5-7.5 22-26
soft-medium 3
Cultivar
Propagated from the adventitious plantlets on the floral stalk

A variant obtained by spontaneous mutation from tissue cultured plants of *Echinodorus x.* 'Rose' in 1992 at Oriental Aquarium, Singapore. This beautiful specimen (15-30 cm in height) has unique pink coloured young translucent leaves streaked with creamy white veins. The leaves turn green when mature. Strong light coupled with relatively cool environment (22-25 °C) encourages the plant to produce the uniquely coloured young leaves. A beautiful central specimen suitable for medium to large aquariums.

Echinodorus osiris
Echinodorus rubra

WP321 WP312 WO321
WP294 WP481 WO294
pH: 5.5-7.5 20-26
medium hard 3
Brazil
Propagated from the adventitious plantlets on the floral stalk or from eyes of rhizome

A very popular plant sometimes also known as *E. rubra*. This plant has a robust rhizome that produces long petioled leaves. When the plantlets emerge from the floral stalk and are transplanted underwater, they will produce permanently submerged leaves with short petioles which are 20-30 cm long and 5-7.5 cm broad. The mature leaves are green while the young leaves are reddish brown to golden brown with undulating margins. This plant is an ideal solitary centre piece.

Echinodorus 'Ozelot'

WP833 WP937 W0833
WP835 WP939 WP963
pH: 6-7.8 20-30
soft-hard 3
Cultivar
Propagated from the adventitious plantlets on the floral stalk

A hybrid developed by H. Barth (Dessau, Germany) by crossing between *E. schlueteri* 'Leopard' and *Echinodorus* x. 'Barthii'. This variety has tanned leaves with brown speckles. These spots are quite dark on young leaves and can even be retained in low light conditions. As the leaves grow, these spots are loosely scattered on leaf blade.

Echinodorus 'Ozelot Green'

WP875 WP955 WP957
WP874 WP954 WP956
pH: 6-7.8 20-30
soft-hard 3
Cultivar

Propagated from the adventitious plantlets on the floral stalk

Oriental Aquarium, Singapore, discovered this mutant from the micropropagated plants of normal Ozelot plants. The leaves are light green to dark green with dark brown speckles, hence the spots are more pronounced.

Echinodorus parviflorus
Echinodorus peruensis

WP111 WP418
WO111 WP624
pH: 6.5-7.5 20-25
soft-hard 4
S. America

Propagated from the adventitious plantlets on the floral stalk

This species is closely related to *E. amazonicus*. Emersed form produces dwarf leaves but in submerged conditions, it produces broadly lanceolate leaves with tapering ends or with cordate base. The leaves are 20-25 cm long and 3.5-5 cm broad with dark red brown veins. This plant is very attractive with its dark veined leaves (40-60 in number) arranged in rosettes and can be grown as a centre piece in medium to large tanks.

Echinodorus parviflorus 'Tropica'

WP114 WP281 WO114

pH: 5-5.8 21-26

soft-hard 3

unknown

Propagated from the adventitious plantlets on the floral stalk

A small species characterised by its puckered leaves. The leaves are about 12 cm long and about 5 cm broad. The leaf blade has a cuspidate tip and tapered base. All lateral veins and the midrib merge at the tip of the blade and form a spine like extension. Depending upon the light conditions the plant can vary its height. They are attractive when planted in groups.

Echinodorus 'Phyton'

WP1130

pH: 5.8-7.5 20-28

soft-medium 3-4

cultivar from Dennerle GmbH

Propagated from the adventitious plantlets

Echinodorus quadricostatus var. madalengensis

WP103 WP492 WO103

WP102 WO102

pH: 6-9 20-30

soft-hard 1

Central America

Propagated from runners

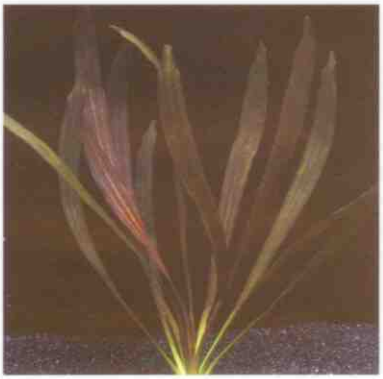
This dwarf Amazon sword plant produces bright green leaves with no petiole. The leaves are placed horizontally and are about 5 cm long and 0.5-1 cm broad when grown emersed. The submerged form develops longer leaves, 5-15 cm long and 1 cm broad. Similar to *E. latifolius*, this plant produces runners and it will only develop large leaves under excellent conditions.. A drop in temperature to as low as 15 °C is not detrimental to this plant. An ideal foreground plant in-groups.

Echinodorus 'Red Flame'

WP976 WP990
pH: 6-7.8 20-30
soft-hard 3
Cultivar

Propagated from the adventitious plantlets on the floral stalk

This form has tanned leaves, but the density of the brown spots is higher, hence the epithet 'Red Flame' is given to this variety. A hybrid developed by Hans Barth of Dessau, Germany.



Echinodorus 'Rubin Narrow Leaf'

WP994 WP993
pH: 6-7.5 18-28
soft-hard 3
Cultivar

Propagated from eyes of rhizome

This variety is a narrow leafed form of *E.* 'Red Rubin'. It resembles *E.* 'Red Rubin' in all aspects except for the width of the leaf. The leaves are 1-1.5 cm broad. This plant can be a good choice for mid-ground settings.

Echinodorus 'Red Rubin'

WP554 WP695 WP1080
WP637 WP959
pH: 6-7.5 18-28
soft-hard 3
Cultivar

Propagated from the adventitious plantlets on the floral stalk or from eyes of rhizome

A very beautiful hybrid between *E. horemanii* 'Red' and *Echinodorus* x. 'Barthii'. The submerged ruby red leaves with prominent creamy veins on short petioles can give a very good contrast. Leaves are lanceolate and are 15-35 cm long and 3-5 cm broad. A good solitary plant, that can be ideally placed in mid to background position in a large aquarium.

Echinodorus 'Rose'

WP510 WP669 WP699
WP837 WP941 WP962
pH: 5.8-7.5 20-28
soft-hard 4
Cultivar

Propagated from the adventitious plantlets on the floral stalk or from eyes of rhizome

An hybrid developed by H. Barth by crossing *E. horemanii* 'Red' and *E. horizontalis*. This plant has pink coloured young leaves with attractively undulating margins sometimes spotted, which on maturity will turn brownish green to green. This plant is less demanding and can grow to about 40 cm in height. It is an ideal mid-ground specimen for medium to large tanks.

Echinodorus scaber

WP495
pH: 6-7.5 20-28
soft-hard 3
S. America

Propagated from the eyes of rhizome

Echinodorus schlueteri

WP380 WP387
WO380 WP483
pH: 6-8 20-28
soft-hard 3
S. America

Propagated from the adventitious plantlets on the floral stalk

A dwarf sword plant with lanceolate to ovate leaf laminne borne on short petioles. The younger leaves often have scattered brown spots which will fade as they mature. This plant can reach a height of 30 cm in its natural habitat but in the aquarium, it will not grow more than 25 cm. It can be planted in small aquariums as they will remain short. Like other species, this plant also requires a substrate rich in nutrients.

Echinodorus schlueteri 'Leopard'

WP511

pH: 6-8 20-28

soft-hard 3

Cultivar

Propagated from the adventitious plantlets on the floral stalk

This plant is the result of another successful breeding attempt by H. Barth in 1988. This plant can reach up to 15 cm in height. The light green leaves have very distinctive red-brown spots which are more or less clear even on older leaves. The leaves are ovate with slightly lobed base. This plant requires strong light. An ideal mid-ground plant.

Echinodorus species

WP1133 WP571 WP496

pH: 6-7.5 22-28

soft-hard 4

unknown

Propagated from the adventitious plantlets on the floral stalk

This plant can grow to a height of 50 cm. The emergent leaves are lanceolate, dark green and 14-30 cm long and about 1.4-2 cm broad. The petiole is slightly longer than the leaf lamina. It can be cultivated in the mid-ground position of the tank.

Echinodorus species 'Gabrieli'

WP1159 WP977

pH: 5.8-7.5 23-28

soft-hard 2

unknown

Propagated from the adventitious plantlets on the floral stalk

An orbiculate sword plant of medium height and wide growth. The emersed leaves are egg shaped with pointed tip, dark green and about 20 cm long and 6 cm broad. The submersed plant has leaves with short petiole and curly leaf blade. The submerged leaves are brownish green in colour.

Echinodorus species 'Harbich'

WP987

pH: 6.5-7.5 22-28

soft-hard 3

Cultivar

Propagated from the adventitious plantlets on the floral stalk

This plant is a mutant, obtained from the culture of *E. cordifolius*. This beautiful plant can reach a height of 10-20 cm with more wide growth. The circular leaves are borne on short petioles and are arranged in dense rosettes. This species looks like a miniature form of *E. cordifolius* and is ideal for foreground or midground decoration in the tanks.

Echinodorus species 'Long Leaf'

WP664

pH: 6-7.5 22-28

soft-hard 3

Cultivar

Propagated from the adventitious plantlets on the floral stalk

This plant can grow to a height of 50 cm. The emergent leaves are lanceolate, dark green and 14-30 cm long and about 1.4-2 cm broad. The petiole is slightly longer than the leaf lamina. The submerged ones are light green with brown patches. However, this plant soon develops floating leaves and becomes less attractive. It can be cultivated in the mid-ground position of the tank.

Echinodorus tenellus

WP116 WP417 WO116

WP115 WO115

pH: 5.5-7.5 18-28

soft-medium hard 1

S. America

Propagated from runners

The smallest species of this genus and there are 2 forms, *E. tenellus* (microleaf variety) and *E. tenellus* 'Broad Leaf'. The micro leaf variety, where its submerged leaves are narrowly lanceolate, only 3-5 cm long and 1-2 mm broad, under strongly lit conditions. The same plant produces longer leaves (up to 12 cm long) when it is planted in poorly lit areas.

Echinodorus tenellus 'Broad Leaf'

WP935 WO935
WP945 WO945
pH: 5.5-7.5 18-28
soft-medium hard 1
S. America
Propagated from runners

E. tenellus 'Broad Leaf' is about 0.4 cm broad, but length varies (12-30 cm) depending upon the light intensity. Under favorable conditions, these plants soon cover the substrate by producing runners thus producing a lawn effect in the aquarium. They require plenty of light, perform best at a temperature of 20 °C, though it can exhibit good growth in a wide range of conditions.

Echinodorus uruguayensis

WP659 WP656
WP964 WP960
pH: 5-8 15-26
soft-medium hard 3
S. America
Propagated from the adventitious plantlets on the floral stalk

A decorative species characterised by long dark olive-green lanceolate leaves with undulating to curved margins. Even though this species bears some resemblance to *E. major* with respect to leaf shape, it differs from the latter by its leaf colour and size. The leaves can attain 30 cm long and 3 cm broad in submerged conditions. This plant can be grown emersed, but, aerial leaves are shorter and the leaf lamina is ovately lanceolate. A good solitary specimen.

Genus EGERIA
Family HYDROCHARITACEAE

Egeria densa

WP120 WP376 WO120
pH: 5-8 15-26
soft-hard 4-5
S. America
Propagated from cuttings

This genus originates from South America where they are fairly wide spread. They are often confused with *Hydrilla*, which is rather rougher textured.

The leaves with narrowly lanceolate leaf blades are arranged in whorls of 3-6 for the most part and light to bright green. Leaf margin is finely toothed. Leaf blade of *E. densa* is broader (0.3-0.4 cm) than that of *E. najas* (0.1-0.2 cm). These plants are somewhat brittle and easily broken; these broken stems can develop into new plants. This is one of the a few genera which can utilise carbonate from water for photosynthesis. They also act as a biological purifier to bring down carbonate hardness.

They require plenty of light and nutrient rich medium and generally prefer cool environment.

Egeria najas

WP551 WO551
pH: 5-8 15-26
soft-hard 4-5
S. America
Propagated from cuttings

Genus EICHHORNIA
Family HYDROCHARITACEAE

This genus comes from the tropics and subtropics of South America and Africa.

E. azurea can produce submersed leaves only for a short period. These horizontally arranged sessile leaves on opposite sides of the stem are 10-25 cm long and about 1 cm broad. The solitary stem of this plant quickly grows out of the water and develops rounded leaves with petiole. The small plants from the rhizome segments can be planted in aquariums. *E. diversifolia* has submerged leaves borne on long shoot axes which are almost 10 cm long and 0.2-0.5 cm broad. It is a demanding plant to grow in the aquarium. This species will produce many branches underwater.

These 2 species require plenty of light as well as nutrient rich medium. *E. azurea* is an excellent centre piece specimen while *E. diversifolia* is ideal for foreground position.

Eichhornia azurea

WP469 WO469
pH: 5-7 20-28
soft-hard 3
S. America
Propagated from cuttings

Eichhornia diversifolia

WP774 WO774
pH: 5-7 20-28
soft-hard 3
S. America
Propagated from cuttings

Elatine triandra

WP1132 WO1132
pH: 5-7 20-28
soft-hard 3
S. America
Propagated from cuttings

Genus ELATINE
Family HYDROCHARITACEAE

This genus comes from the tropics and subtropics of South America and Africa.

Eleocharis acicularis

pH: 5.5-7.5 5-25
medium-hard 1
Temperate zone
Propagated from runners

Eleocharis acicularis is a hardy species and fairly well distributed in the temperate zones of America, Asia Europe and Australia. This particular species can be cultivated in unheated tanks in temperate regions as it can sustain growth at temperatures as low as 5°C. Thinning is necessary when this plant is overcrowded in the aquaria in order to stimulate new growth. Being cold hardy, this plant is suitable to be grown along the edges of ponds in temperate regions, where it can form dense green mat by means of runners.

Genus ELEOCHARIS
Family CYPERACEAE

This genus is distributed worldwide. These marsh dwelling plants are capable of growing underwater in presence of strong light.

The leaves are arranged in rosettes. They are narrow and hair like and are up to 20 cm long (*E. acicularis*), about 7 cm long (*E. parvula)* and more than 10 cm long (*E. vivipara*). *E. acicularis* and *E. parvula* produce runners while *E. vivipara* produces new plants at the tip of the leaves, as the name indicates. Both of these species *E. acicularis* and *E. parvula* are particular with regard to temperature (20-25 °C) unlike *E. vivipara*. *E. vivipara*, however requires additional warmth to survive in winter. All of these plants are ideal for 'lawn making' in the aquarium.

Eleocharis parvula

WP118 WP415 WO118

pH: 5.5-7.5 18-25

medium-hard 1

Tropics

Propagated from runners

Eleocharis vivipara

WP119 WP1091 WO119

pH: 5.5-7.5 20-25

medium-hard 3

Tropics

Propagated from plantlets on the tip of old leaves

Though this plant originates from southern North America, it is now widespread in the tropics. *E. vivipara* prefers brightly lit area in the tank, otherwise it is an undemanding plant.

Genus ERIOCAULON
Family ERIOCAULONACEAE

The genus, *Eriocaulon*, includes about 400 species, and is widely distributed throughout the world. This genus is mostly made up of wetland and aquatic species. All these plants (commonly called pipeworts) are easily recognised by the inflorescence, which is globe like with tightly packed flowers on a long stalks. Two species, *E. cinereum and E. setaceum* from South Asia are gaining recognition as good aquarium plants. *E. cinereum* has submersed leaves in basal rosettes, which are linear and 2-8 cm long and 0.1-0.2 cm broad. The narrow hairy submersed leaves of *E. setaceum* are less than 0.1 mm broad and 3-8 cm long, light green and spirally arranged on whitish cylindrical stem. The crown with tuft of these light green leaves is really striking when planted in-groups in mid-position of the aquarium. This species is more adaptable to aquarium conditions than *E. cinereum*.

Eriocaulon cinereum
WP1033
pH: 6-7.2 20-26
soft-medium hard 1-2
East Asia
Propagated from seeds

Eriocaulon setaceum
WP1042
pH: 6-7.2 22-28
soft-medium hard 3
S. Asia
Propagated from cuttings

Genus GLOSSOSTIGMA
Family SCROPHULARIACEAE

The plant species, *G. elatinoides*, is one of the smallest aquarium plants and is usually found in Australia and New Zealand. Takashi Amano has used this plant extensively in his aquariums. Under bright light and additional CO_2 injection, this small plant grows prostrate along the substrate and soon will form a "green carpet".

The trailing stem develops small egg shaped opposite leaves (0.3-1.2 cm long and about 0.2- 0.6 mm broad) which are dark green in colour. Under poor light the stem will grow upright and thus unable to form a "carpet."

A demanding plant requiring soft water and nutrient rich bottom in addition to bright light and additional CO_2 injection.

Glossostigma elatinoides

WP799 WP635 WO799
pH: 5.5-7 15-26
soft 1
Australia, New Zealand
Creeping plant
Propagated from cuttings

Glossostigma diandrum

pH: 6.2-7 22-28
soft-medium 1
Australia Creeping plant
Propagated from cuttings

G. diandrum, a prostrate herb, is a native of Asia, Africa and Australia. It is generally found in swamps, inundated areas and occasionally in rice fields. The leaves are opposite and linearly spathulate, up to 1.5 cm long and less broader than that of its closely related species *G. elatinoides*. The major difference between *G. diandrum* and *G. elatinoides* is the number of stamens; the former bears 2 stamens in the bell shaped flower while the latter 4 stamens. This plant is not as popular as *G. elatinoides*. However, some report suggests that it can perform better than the popular species in tropical aquariums.

Gymnocoronis spilanthoides

WP123 WP684 WO123

pH: 5.5-8 15-30

soft-hard 4

S. America

Propagated from cuttings

Genus GYMNOCORONIS

Family ASTERACEAE

This genus is distributed in Tropical South America and is commonly known as the 'Spade leaf plant'.

G. spilanthoides has pale green opposite leaves which are 5-12 cm long and about 2 cm broad. A variety, *G. spilanthoides* 'Variegated' has variegated leaves of the same size. Leaves are lanceolate with soft wavy margins. It is a hardy species which can adapt to most conditions. However, the plant grows quickly and often extends out of the water. They should be planted in the shaded area in the tank for faster adaptation to submerse growth. Once acclimatised to aquarium conditions, the plants should be exposed to strong lighting. A fast growing one and a good biological filter of nutrients. A good choice for algae-infested aquariums.

Gymnocoronis spilanthoides

'Variegated'

WP531 WP806 WO531

pH: 5.5-8 15-30

soft-hard 4

Cultivar

Propagated from cuttings

Genus HETERANTHERA
Family PONTEDERIACEAE

This genus comprises about 10 species extending from Africa to America. They grow in still water and in marshy areas.

H. dubia is a native of Mexico, Cuba and the United States . The feeble stem of *H. dubia* is about 1 m long on which long narrow leaves (about 7.5 cm long and 0.5 mm broad) are arranged alternately. The leaves are often undulate and curved. They produce bright yellow flowers above the water surface. It is a hardy species which can grow over a wide range of temperature and hard water. They can be planted in the background.

H. zosterifolia (water star grass), a native of Brazil, has a fragile stem, and often develops roots from the node. Under suitable conditions they branch quickly and attain a bushy growth. The bright green leaves are alternate and are broader (0.5-0.7 cm), but shorter (about 5 cm) than those of *H. dubia*. The internode is very short, giving the impression that these narrowly lanceolate leaves are arranged in whorls. They produce blue blooms above the water surface. They are more demanding and prefer medium soft water with neutral pH.

Heteranthera dubia

WP768 WO768
pH: 6.5-7.5 18-27
soft-hard 4
USA, S. America
Propagated from cuttings

Heteranthera zosterifolia

WP126 WO126
pH: 6.2-7 22-26
soft-medium soft 3
Brazil
Propagated from cuttings

Hottonia palustris

WP1096 WP1013

pH: 6.2-7 10-20

soft-medium hard 3

Europe

Propagated from cuttings

Genus HOTTONIA
Family PRIMULACEAE

The species *H. inflata* inhabits the cold and temperate zones of the Northern Hemisphere (United States and Venezuela). This plant has finely divided leaves which are bright green while the leaves on the lower half of the stem have silvery tints. They only thrive well in cold water aquariums with a temperature range from 10 °C to 22 °C. These plants should be planted in-groups and regular pruning will encourage the development of side shoots making the plant more bushy.

Houttuynia cordata

WP397

pH: 6-7.5 20-27

soft-medium hard 3

East Asia

Propagated from runners

Genus HOUTTUYNIA
Family SAURURACEAE

H. cordata grows wild in Japan, China, India, Indonesia and Taiwan. This perennial with root runners often grows as weeds in ditches along the roadside in its natural habitat. The leaves are cordate, dark green, 4-8 cm long and 3-6 cm wide. It produces spike inflorescence with 4 large white bracts at its base. This bog plant can be cultivated along the pond margins or in terrariums. There are reports that it can adapt to aquarium conditions better than its related *Saururus sp.*

Genus HYDRILLA
Family HYDROCHARITACEAE

This genus has only one species, *H. verticillata* which is distributed worldwide. The bright green translucent leaves are arranged in whorls of 3-6 on a profusely branched stem. The leaves are lanceolate and 1.5-2.5 cm long and 0.1-0.2 cm broad with toothed margins. *Hydrilla* differs from *Egeria* by its roughly textured leaves due to the dentate margin as well as the spiny growth on the lower side of the mid rib. Flowers are very small and white while *Egeria* produces bigger flowers. They can thrive both in cold water and warm water. In winter (5-7°C), they survive by producing winter buds. This plant can convert night time CO_2 to carbohydrate malate and during daytime it draws CO_2 from this compound to carry out photosynthesis.

Hydrilla verticillata

WP127 WO127
pH: 6-8 15-28
soft-hard 3
Cosmopolitan
Propagated from cuttings

Genus HYDRCOTYLE
Family APIACEAE

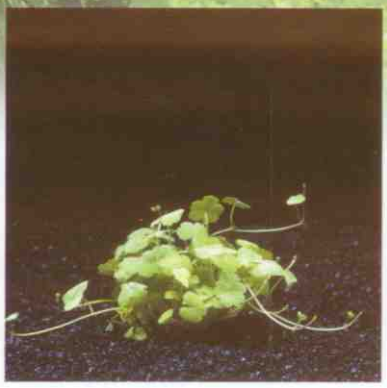
They are commonly known as pennyworts. This genus includes 100 over species, but only a few species can adapt to submersed growth.

H. leucocephala and H. *verticillata* originate from America while *H. vulgaris* comes from Europe and Africa. Another species *H. sibthorpioides* is found in South East Asia.

H. leucocephala has kidney shaped leaves with cernate margins. The petiole runs in to deepest point of the cut on the leaf lamina. *H. sibthorpioides* has leaves that are nearly lobed to form 2-4 lobules. The petiole attachment is similar to that of *H. leucocephala*. *H. verticillata* has bright green leaves that are shield-like and not incised at the base. Development of roots from the node is common for *H. leucocephala* and *H. verticillata*. All these plants have a strong tendency to float along the water surface.. Of these three species, *H. leucocephala* can adapt to all types of aquarium conditions and can tolerate very hard water while *H. sibthorpioides* is more difficult to cultivate. All plants are decorative and can be placed in the mid ground to foreground position or at the front corners.

Hydrocotyle leucocephala

WP128 WP403 WO128
pH: 5-9 15-28
soft-hard 4
S. America
Creeping plant
Propagated from cuttings



Hydrocotyle sibthorpioides

WP497

pH: 6-7.5 20-28

soft-medium hard 2-3

S. E. Asia

Creeping plant

Propagated from cuttings

Hydrocotyle verticillata

WP498

pH: 5-8 10-26

soft-medium hard 3

S. America

Creeping plant

Propagated from cuttings

Hydrotriche hottoniiflora

WP533 WP642 WO533

pH: 6-7.2 20-26

soft-medium hard 4

Madagascar

Propagated from cuttings

Genus HYDROTRICHE
Family SCROPHULARIACEAE

H. hottoniiflora is a perennial plant from Madagascar . The creeping submersed stem has erect tip of about 50 cm long depending upon the depth of the water. The plant produces needle shaped leaves (3-5 cm long and 0.05 – 0.2 cm in thick) in whorls of 10-20. This plant requires generous light and medium soft water with neutral pH.

Genus HYGROPHILA
Family ACANTHACEAE

Presently, the genus *Hygrophila* embraces all species previously belonging to *Nomaphila*. The genus *Nomaphila* is now going into oblivion. There are around 90 species reported in this aquatic genus of Acanthaceae, but not all has been precisely described or classified. Although this genus is cosmopolitan, most of the species originate from Asia.

Hygrophila corymbosa
Nomaphila stricta

WP166 WP328 WO166
WP165 WO165
pH: 5-8 20-28 soft-hard
4 S. E. Asia
Propagated from cuttings

Commonly known as temple plant or cherry leaf plant, this species has leaves which are broadly lanceolate and about 10 cm long and 5 cm broad with an extended apex. The stem is brownish to reddish green. The blue green leaves turn light green when grown underwater and are not as broad as the emersed leaves. The leaves closer to the light source develop pale red colours. This plant requires nutrient rich medium and bright light.

***Hygrophila corymbosa* var.**
angustifolia

WP164 WP337 WO164
WP163 WP421 WO163
pH: 5.5-7.5 20-26
soft-medium hard 4
S. E. Asia
Propagated from cuttings

This plant is a native of East Asia, Indonesia, Australia and New Zealand. It has pale green lanceolate leaves which is whitish green on the underside. The opposite submersed leaves are 7.5 –10 cm long and 0.5-1.2 cm broad. The plant should be pruned regularly to encourage the side shoots to develop. The emersed form will take a long time to establish in the tank and are sometimes unsuccessful. An ideal background plant in-groups for medium to large tanks.

***Hygrophila corymbosa* var.**
salicifolia

WP167 WP700 WO167
pH: 5-9 15-30
soft-hard 4
S. E. Asia
Propagated from cuttings

Hygrophila corymbosa var. siamensis

WP171 WP329 WO171
WP170 WP607 WO170

pH: 5.5-8 20-28

soft-hard 4

S. E. Asia

Propagated from cuttings

An extremely hardy plant suitable for beginners. The blue green emersed leaves will turn light green when they grow underwater. The lanceolate submersed leaves are 5-12 cm long with soft wavy margins. The apical portion of the shoot should be pinched frequently in order to keep the plant submersed.

Hygrophila corymbosa 'Compacta'

WP886 WP973
WP893 WP974

pH: 6.5-7.5 22-28

soft-medium 2-3

cultivar

Propagated from cuttings

A horticultural variety with its physical form much short than the *H. corymbosa*. The light green submerged leaves with silvery-white underneath (about 5cm long and 3cm broad) are arranged in tufts, as the internodes are very short. Under bright light, the leaves attain a brown hue. Ideal for mid-ground planting as it grows around 10cm in height. Strong illumination is the prerequsite for the proper maintenance in the aquarium otherwise it will shed its lower leaves.

Hygrophila corymbosa var. siamensis 'Small Leaf'

WP548 WP619 WO548
WP887 WP636 WO887

pH: 5.5-8 20-28

soft-hard 4

S. E. Asia

Propagated from cuttings

Hygrophila difformis

WP537 WP212
WP287 WO212

pH: 6.2-7.2 24-28

soft-medium hard 4

S. E. Asia

Propagated from cuttings

This species, also known as water wisteria, has aerial ovate leaves with toothed margins. These deep green emersed leaves become deeply incised and turn lime green when they grow underwater. They grow prostrate in strongly lit areas. If there is not enough light, growth will be upright with long internodes as well as less divided leaves. A thermophilic species (heat loving) which does well in an aquarium with temperature above 24 °C.

Hygrophila difformis 'Variegated'

WP346 WP344 WO346

pH: 6.2-7.2 24-28

soft-medium hard 4

Cultivar

Propagated from cuttings

H. difformis 'Variegated' has creamy white veins on the green leaf blade. This 'Variegation' is not a stable feature; as the plant grows, the variegation on the old leaves becomes less distinct.

Hygrophila lacustris

WP169 WO169

WP168 WO168

pH: 5.8-7 22-27

soft-medium hard 3

Thailand

Propagated from cuttings

Another novelty from the genus *Hygrophila* from Thailand. Submersed leaves extend upwards to a length of 10-12 cm and about 1 cm broad. The leaves are brownish green and linearly lanceolate. A demanding plant which requires soft-medium hard acidic water. This species, planted in groups, is suited to the midground position of the tank.

Hygrophila polysperma 'Broad Leaf'

WP132 WO132

WP131 WO131

pH: 5-9 15-30

soft-hard 4

unknown

Propagated from cuttings

Hygrophila polysperma

WP130 WO130 WP298

WP129 WO129

pH: 5-9 15-30

soft-hard 4

Tropical Asia

Propagated from cuttings

The original form is a native of India and now widely distributed in Asia. A very hardy and adaptable species. The lanceolate green submersed leaves often acquire a brown hue under strong light. They are 2.5 cm to 5 cm long and 1 cm to 1.5 cm broad. A few plants in the aquarium tank will soon become bushy with the growth of lateral stems. This plant should be pruned regularly, otherwise, it will form a dense growth across the water surface and deprive other plants of light. The leaf size is variable, hence, many varieties such as *H. polysperma* 'Broad Leaf' and *H. polysperma* 'Narrow Leaf' are now common in the aquarium plant trade. An ideal background plant which can create a green curtain across the back of the tank.

Hygrophila polysperma
'Narrow Leaf'

pH: 5-9 15-30
soft-hard 4
Sri Lanka, Thailand
Propagated from cuttings

Hygrophila polysperma
'Rosa Nervis'

WP468 WP485 WO468
WP389 WP608 WO389
pH: 5-9 15-30
soft-hard 4
Cultivar
Propagated from cuttings

The magenta coloured young leaves with white veins of this variety is something special. Whether it is mutant or a virus, carried by the plant responsible for the production of these brilliantly coloured leaves is not yet clear. This colour development is only found in the presence of strong light and fades away as the leaves mature. Requirements are otherwise same as that of *H. polysperma*.

Hygrophila species 'Red'

WP174 WP175
WP801 WO175
pH: 6.2-7.2 22-28
soft-hard 4
S. E. Asia
Propagated from cuttings

Almost all species of this genus are predominantly green. This variety comes from South East Asia differs from the rest in its colour. The lanceolate leaves are more or less red with brown tinges. This plant can provide some contrast in the background of green plants. It can be planted in groups in mid-ground to background of medium to large tanks.

Hygrophila species 'Pantanal Wavy'

WP888 WP975 WO888
WP997 WO891
pH: 5.8-7 22-27
soft-medium 3
S.America
Propagated from cuttings

This variety have ruffled linear leaves which can grow up to a length of 10- 12cm and about 1cm broad underwater.

Genus LAGAROSIPHON
Family HYDROCHARITACEAE

This genus, a native of Africa and Madagascar, is a true aquatic. *Lagarosiphon* carries numerous male flowers and a few female flowers in the spathe, a feature that is lacked by two other genera (*Egeria* and *Hydrilla*) of the same family.

Leaves are arranged irregularly on an erect slender stem (perpendicular to the stem), bright green and 1-2 cm long (*L. madagascarensis*) or are about 2 cm long, recurved and substantially stiffer with minutely toothed margins (*L. major*). *L. madagascarensis* demands very soft water and does well in temperature above 20°C while *L. major* loves hard water but grows best at temperatures around 20°C. Both species are most effective in group display in the middle of the tank.

Lagarosiphon madagascarensis

WP512 WO512

pH: 5-7.5 21-26 soft

3 Madagascar

Propagated from cuttings

Lagarosiphon major

WP134 WO134

pH: 6-8 15-24 soft-hard

3 Madagascar

Propagated from cuttings

Lagenandra ovata

WP559
pH: 6.4-6.8 24-27
soft 4
Sri Lanka
Propagated from the eyes of rhizome or from seeds

Genus LAGENANDRA
Family ARACEAE

Plants of this genus are distributed in Sri Lanka and South-West India. This genus comprises of 12 species and some of which can grow as submerse. The species, *L. toxicaria* has a poisonous rhizome.

L. ovata is less suitable for the aquaria as the leaves grow large (up to 90 cm), and it can extend its leaf laminae out of the water. The leaf is lanceolate to oval with gently undulating margins. The leaf is glossy and bright green with pale green on the underside. *L. thwaitesii*, the smallest member of this genus produces two kinds of leaves; one slender with crispate margin while the other oval and gently wavy. Leaves are grass green with silvery edged leaf blade. Both species require soft water with acidic pH. *L. thwaitesii* is suitable for terrariums and aquariums while *L. ovata* is more suitable as a pond plant.

Lagenandra thwaitesii

WP135 WP655 WO135
pH: 6.4-6.8 24-27
soft 2
Sri Lanka, India
Propagated from the eyes of rhizome or from seeds

Genus LILAEOPSIS
Family APIACEAE

This genus comprises 18 species and originates from South America, Australia and New Zealand. They are small herbaceous plants growing on the shore of brooks or submerged, sometimes as deep as 4 m *(L. lacustris)* in the rivers of New Zealand. The real *L. novazealandiae* is a brackish water type and the one under this name in aquarium is a mistaken identity for *L. brasiliensis* from Brazil. Fresh water types of this genus are gaining more ground as good foreground plants.

L. brasiliensis has more or less spathulate leaves (spoon-shaped with pointed tips) that are 3-6 cm long. Another species, *L. sp.* 'Mauritius', from Mauritius, has the leaves that are up to 10 cm long cylindrical and tapering at the tips.

L. brasiliensis can grow in any type of water in a range of temperature. The temperature must be below 28°C for the successful cultivation of *L. sp.* 'Mauritius'. These reproduce by runners and are ideal for foreground decoration. They can replace *E. tenellus* as foreground plants.

Lilaeopsis brasiliensis

WP349 WP350 WO349

pH: 6-8 15-26

soft-hard 1

Australia, New Zealand

Creeping plant

Propagated from runners

***Lilaeopsis species* 'Mauritius'**

WP953

pH: 6-8 15-26

soft-hard 1

Mauritius

Creeping plant

Propagated from runners

Genus LIMNOPHILA
Family SCROPHULARIACEAE

Limnophila aquatica
WP137 WO137 WP986
pH: 6-7 22-26
soft-hard 3
S. E. Asia
Propagated from cuttings

The species of this genus are perennial herbs, inhabiting the damp areas in southern Asia, East Africa and Australia. In its natural habitat they grow as weeds in the rice fields. Leaves are arranged in whorls. The aerial leaves are generally lanceolate with toothed margins.

When they grow underwater, leaves are deeply divided into fine green segments which are 5-6 cm long (*L. aquatica*) hence, the plant measures 10-12 cm in diameter or the leaves are 2-3 cm long (*L. sessiliflora*) so the plant has a diameter of 4-6 cm. Aerial leaves are entire with dentate margins for the former while it may be moderately pinnate or lanceolate for the latter. The purplish green opposite leaves of *L. aromatica* is entire with dentate margins even when they are submerged. This plant produces beautiful pink or purple flower in terrariums. Another form, *L.* sp. 'Gigantea' develops pinnately divided leaf underwater like that of *L. aquatica*, but, the leaves near the shoot apex are pale green with red tinge.

Limnophila aromatica
WP139 WO139
WP138 WP609 WO138
pH: 6.4-7 20-25
soft-medium soft 3
Tropical Asia
Propagated from cuttings

Limnophila 'Brownii'
WP846 WO846
pH: 6.5-7.5 20-25
soft-medium 4
Australia
Propagated from cuttings

Limnophila hippuroides

WP970 WO970

pH: 5.8-7.2 20-28

soft-medium 3

America

Propagated from cuttings

This plant is usually found in the tropical parts of North America. It was considered as a species of the genus *Gratiola*. A perennial herb with light red to purple, non-hairy stem bearing leaves in whorls of 3. The purplish green aerial leaves are 2-4 cm long and 0.3-0.7 cm broad. The leaves will turn deep purple or pinkish when they are grown submerged. This plant produces flowers on the axes of the leaves and also at shoot apices. With such deep purple or pink leaves, it will provide a effective colour contrast in presence of green plants. An ideal mid-background plant in groups.

Limnophila sessiliflora

WP142 WP352 WO142

WP141 WP942 WO141

pH: 6.5-7 20-25

soft-medium soft 4

S. E. Asia

Propagated from cuttings

Limnophila species 'Gigantea'

WP649 WP140

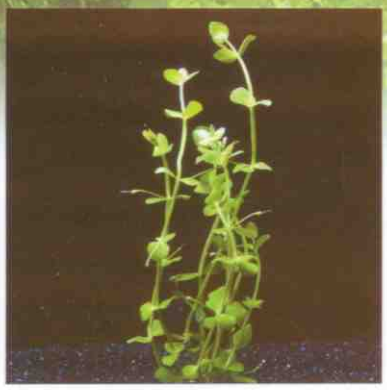
WP648 WO140

pH: 6.5-7 22-28

soft-medium 4

S. E. Asia

Propagated from cuttings



Lindernia rotundifolia

WP150 WO150

pH: 6-6.8 22-26

soft-medium hard 3

Tropical Asia

Propagated from cuttings

Genus LINDERNIA
Family SCROPHULARIACEAE

The plant species of this genus generally grow on wet lands and are not true aquatic. The species, *L. rotundifolia*, a native of tropical Asia, can however adapt to submersed growth .

L. rotundifolia is a perennial. The stem is upright with opposite sessile leaves, circular in shape that are 0.7-1.3 cm long and 0.5-0.8 cm broad. The plant can reach about 30 cm in height. They look very attractive when they are planted in groups in the middle of the tank. Another variety, *L. rotundifolia* 'Variegated', has leaves with creamy white midrib and veins on the bright green leaf blade, is more striking than the normal green leafed one.

Lindernia rotundifolia 'Variegated'

WP515 WP618 WO515

pH: 6-6.8 22-26

soft-medium hard 3

Cultivar

Propagated from cuttings

Genus LOBELIA
Family COMPANULACEAE

This genus includes 365 species and many of them grow in wetland or occasionally flooded regions. One species, *L. dortmanna*, a true aquatic, inhabits in the acid lakes of North America and sub-Arctic Europe, cannot be grown in aquariums.

L. cardinalis has its origin of North America where it can be found in the Temperate Zone to warm areas of Florida. This is more than an aquatic plant because of its beautiful scarlet red blooms, hence, it is also cultivated in gardens. This plant has a fleshy stem with alternate leaves which are elliptical to circular. The aerial leaves is reddish green with purple on the underside. When grown underwater, the leaves will turn bright green.

A slow growing species which requires plenty of light and neutral pH. Being a slow grower, planting across the mid-ground in-groups is more ideal.

Lobelia cardinalis

WP143 WP246 WO143
pH: 6.2-7 20-26
soft-medium hard 3
USA
Propagated from cuttings

Lobelia cardinalis
'Small Form'

WP524 WP625 WO524
pH: 6.2-7 20-26
soft-medium hard 3
Propagated from cuttings

A miniature version, *L. cardinalis* 'Small Form' exhibits all characteristics of normal one except for its dwarf nature. It develops small rounded purplish aerial leaves. Under submerged conditions, leaves will be more or less elliptical and light green in colour.

Genus LUDWIGIA
Family ONAGRACEAE

Although this genus is cosmopolitan in distribution, majority of them are reported in North America, a few in tropical Africa, Asia and Australia but only one species has been found in Europe. There are about 75 species and many of them (about15 species) can adapt to submerged growth. All these species, especially those growing in heated tanks will drop their basal leaves at the advent of winter.

Ludwigia arcuata

WP145 WO145 WP984

pH: 6-7.2 18-25

soft-medium hard 3

USA

Propagated from cuttings

A beautiful plant from Virginia and Florida of North America. They grow prostrate on wet lands with erect tips. Aerial leaves (0.5-2 cm long and about 0.25 cm broad) are alternate, lanceolate and green in colour. The stem will be erect when they grow submerged. The submersed leaves are longer and narrower, and develop brick red to reddish brown colour. This elegant plant is really an eye catcher when planted in the middle or in the corners of aquarium.

Ludwigia brevipes

WP971 WO971

pH: 6-7.2 18-25

soft-medium 3

USA

Propagated from cuttings

A attractive plant which originates from the Southeastern coast of North America. It bears close resemblance to *Ludwigia arcuata*. The leaves are sessile, linear to lanceolate and curvy. These are about 3cm long and about 0.4cm wide with olive green upper side and pale reddish lower side. Its wide growth makes it more suitable for mid-ground to foreground decoration in the aquarium.

Ludwigia grandulosa
Ludwigia 'Perennsis'

WP444 WP982 WO444
pH: 6-7.4 22-28
soft-medium hard 3
East Asia
Propagated from cuttings

This species grows in wetland areas in Taiwan. The upright stem with alternate leaves can reach 40 cm in height. The leaves are reddish green to deep red, lanceolate and 4-7 cm long and about 1.8 cm broad. They are ideal mid-ground plants.

Ludwigia inclinata
WP520 WP61.
WO520 WP94·
pH: 5-7 20-26
soft-medium hard 3
South America
Propagated from cuttings

WP944

A very decorative plant originating from South America. The yellow orange leaves (1-5 cm long and 0.3 –1.2 cm broad) are opposite, elliptical and undulating. Flowers are yellow with four petals. Lateral branches often develop from the axes of leaves.

Ludwigia inclinata 'Green'

WP988 WP1000 WO988
pH: 5-7 20-26
soft-medium hard 3
South America
Propagated from cuttings

Another form *L. inclinata* 'Green' exhibits similar growth, but its leaves are light green. Unfortunately, this plant is extremely demanding and require soft acidic water and generous lighting. They shed their basal leaves in poorly lit areas. This plant grown in groups in the centre of the aquarium is really attractive.

Ludwigia ovalis

WP540 WP995 WO540

pH: 6-7 22-28

soft-medium hard 3

East Asia

Propagated from cuttings

This fragile plant is a native of Japan, Thailand and China. It has an upright stem with opposite leaves. The gently wavy leaves (1.5-2.7 cm long and 0.8-1.4 cm broad) are alternate, oval and brownish green. Like *L. inclinata*, this species also require bright light otherwise, they will drop their leaves. They are ideal mid-ground specimens.

Ludwigia palustris

WP146 WP677 WO146

pH: 6.5-7.4 20-30

soft-hard 3

Warm temperate

Propagated from cuttings

This species inhabits in the marshy areas of North America, North Africa, Asia, and Europe. The opposite green leaves with red on the underside are attached to the stem with a short petiole. The submerged leaves are slightly shorter and narrower. These plants should be pruned regularly in order to make them more bushy and also to prevent dense growth across the surface of water. Another form, *L. palustris* 'Green' has leaves which are bright green in colour. They can be planted in the aquarium in a group of 4-6 in the middle of the tank.

Ludwigia palustris 'Green'

WP769 WO769

pH: 6.5-7.4 20-30

soft-hard 3

unknown

Propagated from cuttings

Ludwigia repens

WP149 WO149
WP148 WP615 WO148
pH: 6.5-7.5 20-30
soft-hard 3
America
Propagated from cuttings

They are found in marshes and shallow waters in southern United States, Central America and in the Caribbean Islands. A very polymorphic plant and it exhibits this character from one area to another. They readily cross with other species of this genus, hence identification of sub species and geographical varieties is difficult. This plant has two leaf forms, one with round leaves slightly elongated and the other with lanceolate leaves. These two forms also appear in different colours, either with green or with red leaves. The leaves are 2-3 cm long and 1.5-2.5 cm broad. Like other species this one is also suitable to mid-ground position.

Ludwigia species

pH: 6-7.2 22-28
soft-medium hard 3
unknown
Propagated from cuttings

This plant develops floating stems with dark green alternate leaves on a cylindrical stem (about 0.3 cm thick) in its natural habitat. The emergent leaves are elliptical, alternate and 2-2.5 cm long and about 0.2-0.6 cm broad. Under submerged conditions, this plant will grow upright. The leaves are slightly longer (2.8-3.3 cm long and about 0.2-0.6 cm broad) and brownish green in colour with pink on the underside. This plant will attain bushy growth by producing many lateral branches from the axes of the leaves. This growth can be sustained by regular pruning. A beautiful aquarium plant planted in groups is suitable for mid-ground position.

Lysimachia nummularia

WP432 WP800 WO432

pH: 6.5-7.5 18-26

soft-hard 3

Europe

Propagated from cuttings

Genus LYSIMACHIA
Family PRIMULACEAE

This genus is almost worldwide in distribution. They are perennial herbs and inhabit in ditches, marshes and wet grasslands.

L. nummularia generally a cold water plant, with shoots creeping on wet soil can adapt to submersed growth. The leaves are almost circular or egg shaped with short petiole and up to 2.5 cm long and 2 cm broad. They are dark green (*L. nummularia*) or lime green (*L. nummularia* 'Aurea') and arranged in opposite on the slender stem. These plants do best at a temperature of 20°C, though they can tolerate a little higher temperature (-26 °C) without showing much stress. The shiny leaves are very attractive when they are planted in groups in mid-ground position.

Lysimachia nummularia 'Aurea'

WP382 WP475 WO382

pH: 6.5-7.5 18-26

soft-hard 3

Cultivar

Propagated from cuttings

Genus MAYACA
Family MAYACACEAE

The family *Mayacaceae* is a monogeneric (having only one genus). There are about 10 species which grow in the tropical and sub-tropical South America and South West Africa.

M. fluviatilis is a small herbaceous plant with a fragile stalk (less than 0.1cm in thickness) on which slender leaves are arranged alternately. The submerged leaves are yellowish green and are 0.8-1.2 cm long and about 0.1 cm broad. It produces violet flowers. Another species *M. sellowiana* has underwater leaves longer (1.2-2 cm) than the former and are alternate on the stem which is about 0.2 cm thick. These plants prefer medium light and soft acidic water. Fish in the aquarium has a detrimental effect on the growth of this plant.

Mayaca fluviatilis

WP235 WP998 WO235

pH: 6.2-7 22-28

soft 3

Brazil

Propagated from cuttings

Mayaca sellowiana

WP832 WO832

pH: 6.2-7 22-28

soft 3

S. America

Propagated from cuttings

Micranthemum micranthemoides

WP152 WP416 WO152

pH: 5.8-7.3 20-28

soft-hard 2

USA & West Indies

Propagated from cuttings

Genus HEMIANTHUS
Family SCROPHULARIACEAE

The plant species *Micranthemum micranthemoides* otherwise known as *Hemianthus micranthemoides* often grows in the moist areas (banks of river) or in ponds in its natural habitat (West Indies and United States). The creepy emersed plant has slender stems on which 3-4 narrowly lanceolate leaves (less than 1 cm long) in whorls and can grow only about 0.5 cm in height. The submerged plant produce erect stems which can grow up to 15 cm in the aquarium. The lime green foliage is very decorative and should be trimmed often to keep its bushy form. Another form of this species which develops only 2 leaves from every node, is hardier and adapts well to tropical aquariums. The former requires rather cool environment (18-20°C) for its robust growth even though they can withstand warm conditions. They are ideal plants in bunches in the mid-ground position.

M. umbrosum grows in central America and South-eastern North America. *M. umbrosum* , unlike *Hemianthus micranthemoides* (syn. *M. micranthemoides*) has upright stems. The pale green leaves are opposite, circular with a diameter of 0.4-0.5 cm. Normally, the cuttings cannot grow well in the tanks. Although it can tolerate warm conditions, it prefers temperature of around 22°C. This plant requires generous light and sufficient room for growth. This delightful species can bring a delicate touch to the mid-ground.

Micranthemum umbrosum

WP526 WP628 WO526

pH: 6-7.2 18-26

soft-medium hard 2

Central America

Propagated from cuttings

Genus MICROCARPAEA
Family SCROPHULARIACEAE

The genus, *Microcarpaea,* is mono-specific (only one species) and generally distributed in South-east Asia and Northern Australia. A small creeping plant that forms mats of vegetation in seasonally inundated areas.

Microcarpaea minima

WP1092

pH: 6.8 24-28

soft-medium 2

Asia & Australia

Propagated from cuttings

M. minima is an annual shrub distributed throughout Asia and Australia. this plant grows in swamps and paddy fields in its original habitat. Stem of this plant is slender (about 0.1 mm in diameter) with many branches. The narrow leaves with characteristic stem clasping are light green, sessile and opposite. They are 3-4 cm long and 0.1-0.2 cm broad. This plant bears pink flowers on the node in an alternate manner. The species is a latest addition to aquarium hobby. It requires good water conditions for healthy growth in an aquarium. It looks very attractive when planted in bunches in the mid-ground.

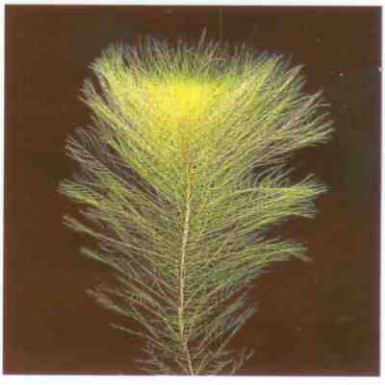
Genus MYRIOPHYLLUM
Family HALORAGACEAE

This genus comprises of about 40 species and is widely distributed around the world. They are commonly known as milfoils. The species originating from America are largely aquatic while most of the Australian species are amphibious in nature. These fragile plants have considerable ornamental value. They can be used to decorate the back and corners of the tank with depth of 30-60 cm. Abundant light is the only prerequisite for these plants otherwise they are adaptable to almost all conditions in the aquarium. However, some species like *M. triphyllum* and *M. alternifolium* from the Temperate Zone cannot grow well in aquariums as they require low temperature.

Myriophyllum aquaticum
Myriophyllum procerpinacoides

WP154 WP351 WO154
pH: 5-7.5 22-30
soft-medium hard
5
Propagated from cuttings

Even though its origin is assigned to Brazil, it is now fairly widespread in South America. Generally known as parrot-feather, named for the feather like appearance of its gray green foliage, almost iridescent leaves. The stem (0.1-0.6 cm thick) can reach 1.5 m in length, with whorls of leaves. Each whorl is made up of 4-6 leaves (about 5 cm long) and each leaf is divided into 8-10 bright green segments on each side of the rib. This feathery green gray foliage with reddish tips makes this species the most beautiful water milfoil. This plant is suitable for the garden ponds.



Myriophyllum dicoccum

WP1100 WO1100
pH: 6-7.2 18-25
soft-medium
5 Australia
Propagated from cuttings

M. dicoccum from Australia is another attractive species with respect to its leaf colour. The emergent leaves are mostly in whorls of 6 but pseudo-whorls of 2-4 are also present. The dark green leaves are slightly toothed at the upper half, spathulate and up to 3cm long and about 0.2cm broad. The finely segmented submerged leaves are brownish green and are shiny under light. It is about 4cm long and has 8 pinnules each (curved upwards) on either side of the mid rib. There is no definite pattern of leaf arrangement for the submerged ones, may be in whorls, pseudo-whorls or sometimes alternate. The flowers develop on the axes of the leaves. As this plant branches profusely along the water surface, trimming is to be done very often.

Myriophyllum hippuroides

WP157 WO157

pH: 6.5-7.2 18-28

soft-hard 5

USA & Mexico

Propagated from cuttings

They are distributed in southern United States and Mexico. This plant has a creeping stout rhizome which bears stems up to 1m long. The leaves are in whorls of 4-6 (about 5 cm long) and divided into 6-10 closely set segments on each side of the rib. The yellowish green leaves especially at the tip of the stem turn red or brown when they are in strong light. The emersed leaves are linear to lanceolate, dentate or smooth edged and about 2.5 cm long.

Myriophyllum elatinoides

WP155 WP362 WO155

pH: 6.5-7.2 15-22

soft-medium hard 5

S. America

Propagated from cuttings

This plant is found in South America, Mexico, New Zealand and Tanzania. The stem often creeping along the mud can grow to almost 1 m long with 3-5 leaves in whorls. The leaves (1-2 cm long and pointed upwards) are dark to bluish green and the leaf blade is divided into fine segments (5-10 on both sides of the midrib). The emersed leaves are either dentate or egg shaped, undivided and up to 1 cm long. This species cannot thrive in tropical climate and is only suitable for colder tanks.

Myriophyllum matogrossense

WP555 WP696 WO555

pH: 6-7.2 22-28

soft-hard 5

S. America

Propagated from cuttings

This form is also found in South America. This plant has a light green stem which is oblique and 30-60 cm long. The pale green leaves (3-3.5 cm long) are in whorls of 3-4. Each leaf has 7-10 segments which are 1-1.5 cm long. The leaves are stiffer than those of red milfoil.

Myriophyllum pinnatum
Myriophyllum scabratum

WP359 WP156
WP411 WO156
pH: 6.5-7.5 18-24
soft-medium 5
USA
Propagated from cuttings

An amphibious species which inhabits the southern parts of the United States and Cuba. This species produces pseudo whorls of leaves rather than true whorls, i.e., one leaf generally sets slightly higher than the other. The leaves are longer in the natural habitat (about 4 cm long) with 20 pinnules, but in the aquarium they produce shorter leaves (2-3 cm) with fewer and shorter pinnules. This plant requires relatively cool and clear water.

Myriophyllum x 'propinum'

WP525 WO525
pH:: 6.7-7.2 20-28
soft-medium hard 5
S. America
Propagated from cuttings

M. propinum is of Australian origin. This plant is closely related to *M. propinqum*. The emerse one looks very similar to that of *M. propinqum* but lacks the reddish brown stem. Though needle-like emergent leaves are usually in whorls of 6, the pseudo-whorl formation is not uncommon under crowded conditions. Under submerged conditions this plant produces finely segmented leaves that are light green.

Myriophyllum propinquum

WP541 WO541

pH:: 6-7.2 20-28

soft-medium hard 5

S. America

Propagated from cuttings

(syn., *M. simulans, M. papillosum*): An Australian species which can grow in water more than 1 m deep. It is a perennial with trailing stems. The light green stem (0.5 cm in diameter) produces leaves in whorls of 5-6. The leaf is divided into fine segments (6-8) which are 0.5-2 cm long and 0.1 cm broad. The leaves will develop a yellow hue under strong light. The flowers are unisexual with white male flowers and brownish red female ones.

Myriophyllum spicatum

WP532 WO532

pH: 6.4-7.5 22-28

soft-hard 3

Tropics

Propagated from cuttings

This genus is wide spread in Central and South America, tropical Africa and Australia. It was later introduced to North America. This robust species can grow up to 3 m long in the water. The stem is profusely branched and is 2-4 mm in diameter. The leaves are in whorls of 4 – 5 (occasionally only 3), with each about 3.5 cm long and divided into 13-36 segments on each side of the rib. This plant can tolerate cool and warm water.

Myriophyllum tuberculatum

WP743 WP357 WO743
WP158 WP375 WO158

pH: 6-7.2 22-28

soft-hard 5

S. America

Propagated from cuttings

South America is the natural habitat of this plant and it is commonly known as red milfoil. The stem and leaves are brownish to rust red in colour. The leaves (up to 5 cm long) are arranged in whorls of 5-7 with 10-12 thread like segments (2-3 cm long) on each side. As the leaves are feathery, the water in the aquarium should be devoid of suspended particles to prevent its accumulation on the leaves. Otherwise algae growth will follow.

Genus NAJAS
Family NAJADACEAE

This genus includes about 50 species and is widely distributed around the globe. This aquatic genus has a wide range of habitats including brackish waters.

The species, *N. indica*, distributed in tropical Asia is characterised by its brittle stem which can easily break into small fragments. This plant rarely has branched submerged stem but it will branch profusely when it floats along the water surface. The leaves are generally opposite but they sometimes form pseudo whorls of 3. The bright green narrowly linear leaves are up to 3.5 cm long. The leaf margin bears 16-20 denticles. As the plant has brittle stem, planting should be done individually. Under low light conditions this plant shed their leaves. *N. guadalupensis*, from Madagascar is fast growing and will soon overgrow the whole tank under favorable conditions. Leaves are dark green and up to 2 cm long.

Najas guadalupensis

WP161

pH: 6.5-7.2 24-28

soft-medium hard 4

Madagascar

Propagated from stems

Najas indica

WP160

pH: 6.5-7.2 24-28

soft-medium hard 4

S. E. Asia

Propagated from stems

Genus NESAEA
Family LYTHRACEAE

Nesaea pedicellata

WP530 WP996 WO530

pH: 5.5-7 22-28

soft 2-3

Tropical West Africa

Propagated from cuttings

This genus contains marsh dwelling small herbs. The popular aquarium species, *N. pedicellata* and *N. crassicaulis* are of African origin.

N. pedicellata, small perennial herb has an upright stem which can grow up to 50 cm. The leaves are lanceolate, opposite and 1.5-5 cm long and 0.5-1 cm broad. Under strong light the leaf develops a yellowish orange colour. This species makes excellent mid-ground plant. Another variety with red leaves, from West Africa has deep red coloured stems and leaves that are striking when planted in the background of green plants. This plant can reach 10-15 cm in height. The deep red coloured leaves are opposite with very smooth surface. This red leafed form is extremely demanding with respect to growth requirements and like *N. pedicellata* prefers soft acidic water.

Nesaea species

WP016 WP622 WO016

pH: 5.5-7 22-28

soft 2

Tropical West Africa

Propagated from cuttings

Genus NUPHAR
Family NYMPHAEACEAE

There are about 20 species and all can thrive in the aquarium. They are commonly known as yellow pond lilies and are usually found in the temperate latitude of Northern Hemisphere. These plants usually grow in still or slow flowing deep waters.

N. japonica is a native of Japan and has a stout rhizome with a rosette of leaves. The submerged leaves have arrow shaped leaf laminae with petioles of varying length. The bright green translucent leaf laminae is up to 30 cm long and 12 cm broad with wavy margins. The floating leaves are fleshy, leathery and dark green in colour. The submerged leaves of another variety, *N. japonica* var. Rubrotincta has a beautiful colour (yellow to brownish red) and it can be a striking specimen plant when planted in the centre of the aquarium.

N. lutea grows in Europe and central west Asia. This yellow pond lily has egg shaped-round leaf laminae with a diameter of 10-15 cm. The leaf lamina is deeply incised at the base and the petiole joins the leaf blade at the deepest point of incision. They are bright green and moderately undulate. The floating leaves are medium green and incised at the base up to the insertion of petiole.

All these plants require nutrient rich bottom with a little clay and plenty of light. Once acclimatized to aquarium conditions, growth will be so fast that it can produce 1-2 leaves every week.

Nuphar japonica 'Spatterdock'

WP231 WP304
WO231 WP180
pH: 5.5-7.3 18-26
soft-medium 3-4
S. E. Asia & Japan
Propagated from eyes of rhizome

Nuphar saggittifolium

pH: 5.5-7.3 18-26
soft-medium 3
North America
Propagated from eyes of rhizome

N. saggittifolium from South Carolina in the United States is a subtropical plant. The leaves are arrow shaped, light green and longish. The leaf blade borne on a long petiole is 20-40 cm long and strongly undulating. In its natural habitat, the development of floating leavees is natural at the advent of winter. Under aquarium conditions coupled with copious light, this plant produces only submersed leaves.

Genus NYMPHAEA
Family NYMPHAEACEAE

The plant species of the genus *Nymphaea*, popularly known as water lilies are used to decorate garden ponds. This genus has about 40 species and a number of horticultural varieties. With their enormous floating leaves, not all species can be cultivated in the aquarium. However, some of the tropical species which are fairly small as compared, can be used for aquarium decoration.

N. lotus grows in Africa and Asia. An extremely variable plant with respect to leaf colour and shape. *N. rubra* has dark red to brownish submerged leaves and beautiful red flowers. The submersed leaves of *N. lotus* 'Green' or *N. zenkeri* 'Green' are smooth wavy and green with speckles while *N. lotus* 'Red' or *N. zenkeri* 'Red' has brownish green leaves, and speckled. Both of these plants are quite well known by their common name 'Tiger Lotus Green' and the latter by 'Tiger Lotus Red'. There are 2 hybrids, *N. species* 'Red' with red coloured leaves under bright light and *N. species* 'Green' with green leaves . *N. micrantha* has similarly shaped submerged leaves but the leaf lamina has light brown to dark blotches and speckled. The submersed leaves of *N. stellata* are brownish red in colour with very ruffled surface. Under bright light, this plant becomes bushy and produces more attractively coloured submerged leaves. The flowers can be blue, pink, red or white.

All these plants require rich substrate and bright light. They develop floating leaves and thus create a lot of shade for other plants in the aquarium. Pruning of floating leaves will promote growth of submerged leaves. However, the removal of these floating leaves will prevent the plants from flowering thus if blooms are desired, allow the leaves to grow to the surface. All *Nymphaeas* make good specimen plants.

Nymphaea micrantha
WP744
pH: 6.2-7.2 22-28
soft-medium hard 3
West Africa
Propagated from plantlets on leaves developing at the point of insertion of petiole

Nymphaea rubra
WP183 WP259 WP184
pH: 6.2-7.2 22-28
soft-medium hard 3
Tropical Asia
Propagated from seeds

Nymphaea species 'Green'
WP181 WO181
pH: 6.2-7.2 22-28
soft-medium hard 2-3
Tropical Asia
Propagated from seeds

Nymphaea species 'Red'
WP182 WP291 WO182
pH: 6.2-7.2 22-28
soft-medium hard 2-3
Tropical Asia
Propagated from seeds

Nymphaea stellata
WP187 WO187 WP188
pH: 6.2-7.2 22-28
soft-medium hard 2-3
Sri Lanka
Propagated from seeds

Nymphaea lotus 'Green'
Nymphaea zenkeri 'Green'
WP185 WP488
WO185 WP227
pH: 6.2-7.2 22-28
soft-medium hard 3
Tropical Africa
Propagated from seeds and runners

Nymphaea lotus 'Red'
Nymphaea zenkeri 'Red'
WP186 WP249
WO186 WP228
pH: 6.2-7.2 22-28
soft-medium hard 3
Tropical Africa
Propagated from seeds and runners

Nymphoides aquatica

WP437

pH: 6.5-7.2 20-30

soft 2

USA

Plant with banana like tubers

Propagated from runner or the plantlets on the leaf blade

Genus NYMPHOIDES
Family MENYANTHACEAE

They are aquatic perennials growing in tropical and subtropical areas of the world. The false water lilies, as they are called, grow almost exclusively floating leaves borne on thin petioles rising from the stiff rhizome.

N. aquatica, commonly known as 'Banana Plant', inhabits shallow waters of the United States. The rhizome develops banana like tubers in a bunch which are 2-4 cm long. The submerged leaves are green, round with a lobed base and undulating margins. The floating leaves are bright green with purplish red on the underside. The development of submerged leaves and floating leaves are associated with seasonal variations in its natural habitat. Its winter leaves are submerged and summer leaves are floating. It has flowers that are white and fringed on the margins. *N. aquatica* can be planted as show specimen. If no floating leaves are desired, they should be planted in sandy substratum, poor in nutrients under medium light conditions.

Another species, *N. species* (unknown identity) develops beautiful bright green submerged leaves which are round to elliptical with lobed base. However, this plant soon develops floating leaves on floating stolons which will cast too much shade for the other plants. As it does not flower in our farm, its identification is yet to be done.

Nymphoides species

WP542 WO542

pH: 6.5-7.2 20-30

soft 2

unknown Plant with stolons

Propagated by dividing stolons

Genus OTTELIA
Family HYDROCHARITACEAE

These plants are annuals and there are about 40 species in this genus. They can be found widely distributed in the tropics from northern Africa, southern tropical Asia to Australia. It is one of the more beautiful aquatic plants but cultivation of this requires experience as it is a demanding plant.

The species *O. alismoides* often grows as a weed in its natural habitat, the rice fields. The very young plants develop ribbon shaped leaves in rosettes and almost sessile. Mature plants have leaves with egg shaped or spoon shaped leaf blades (5-10 cm long and 2.5-7.5 cm broad) borne on long petioles (10-15 cm long). The leaves are light green and very fragile. The flower blooms on the surface of the water, more so when they are planted in the highly lit area in the aquarium tank. *O. ulvifolia*, a native of tropical Africa and Madagascar has attractive foliage. The young plant produces longer and narrow leaves (about 30 cm long and 0.5-2 cm broad). The leaves will be wider and shorter (up to 20 cm long and 8.5 cm broad) as the plant matures. Leaves are usually light green in colour. Under the optimum conditions, the curly leaf blade will attain a blood red tone.

These are very fragile plants which require special attention while growing in the tank. The leaves are very delicate and should be protected from snails and boisterous fishes. The water must be very soft with little calcium in it. Substrate feeding can promote growth. They are ideal specimen plants for the centre of the tank.

Ottelia alismoides
WP190 WP1090
pH: 5.5-6.9 22-28
very soft 3
South Asia
Propagated from seeds

Ottelia ulvifolia
WP845
pH: 5.5-6.9 22-28
very soft 3
Tropical Africa
Propagated from seeds

Physostegia purpurea
Ammoricia aquatica
WP440 WO440
pH: 6-7 22-26
soft-medium hard 2
N. America
Propagated from seeds

Genus PHYSOSTEGIA
Family LAMIACEAE

This genus includes perennial herbs which are native to North America. They are commonly known as false head dragons. *P. purpurea*, a wetland species, can grow submersed as well. The leaves are in rosette and about 17 cm long and 5 cm broad. They are elliptic to lanceolate and dark green in colour. Submersed plants can reach 10 cm in height. This plant produces showy purplish flowers arranged in terminal rhizomes when they grow in its natural habitat. Additional CO_2 fertilisation is necessary for optimum growth in the aquarium.

Genus POGOSTEMON
Family LAMIACEAE

Pogostemon stellatus is a native of Tropical Asia. An annual (or sometimes perennial) herb which can adapt very well to a wide range of aquarium conditions.

The linear leaves with pointed tips are in whorls of 4-10 and about 3-7 cm long and 0.2-0.7 cm broad. Leaf colour is brownish red to maroon when grown submerged. This plant produces terminal spike inflorescence with deep violet flowers.

A strikingly beautiful plant that can be planted in bunches in the centre of the aquarium.

Pogostemon stellatus 'Broad Leaf'

WP1084 WO1085

pH: 6.2-7 23-28

soft-medium hard 4

Papua New Guinea

Propagated from cuttings

Pogostemon stellatus 'Narrow Leaf'

Eustralis stellata

WP122 WP285

WP623 WO122

pH: 5-7 22-28

soft-medium 3

Tropical Asia

Propagated from cuttings

The species *P. stellatus* 'Narrow Leaf', being a very decorative plant, becomes more attractive when they are planted in groups. The leaves are arranged in whorls. The emerse plant has 3-6 leaves in one whorl while the submerse plant has 3-10 leaves in one whorl. This is an extremely demanding plant which requires nutrient rich medium, CO_2 injection and bright light. A good indicator plant with regard to nutrients especially iron as the leaves will turn yellow when the growing medium cannot supply adequate nutrients.

Polygonum pedunculare

WP144 WO144

pH: 5.5-7.5 20-28

soft-hard 4

S. E. Asia

Propagated from cuttings

Polygonum species

WP773 WO773

pH: 5.5-7.5 20-28

soft-hard

4

Propagated from cuttings

Genus POLYGONUM
Family POLYGONACEAE

This genus, almost worldwide in distribution has approximately 150 species. Only a few of the species can grow underwater while most of them inhabiting in the wet land or periodically flooded locations.

The species *P. pedunculare* is from South East Asia. The stem is upright with long internodes. The leaves (5-8 cm long and 2.5-3 cm broad) are alternate with characteristic stem clasping sheath. They are bright green and the leaf blade is more or less triangular. The floating leaves are linear and elliptical. This plant can be grown in the aquarium as well as the terrarium. They can be planted in small groups in mid-background position.

Polygonum sp. another species of unknown origin has become very popular because it can produce brownish green coloured leaves under optimum light conditions. This plant is a true aquatic plant. The leaves with characteristic stem clasping sheath are narrower than that of *P. pedunculare*. When arranged in small groups, they can provide effective contrast against a green background.

Genus POTAMOGETON
Family POTAMOGETONACEAE

The genus *Potamogeton* is a true representative of aquatic plant species, having rooted stem with submerged and floating leaves or only with submerged ones. There are about 100 species and are widely distributed from tropical to temperate zones.

Potamogeton crispus

WP772 WO772
pH: 6.8-9 18-27
medium hard-hard 4
Temperate producing runners
Propagated from cuttings, winter buds and runners

This hardy aquatic perennial is distributed in the temperate zones of Northern Hemisphere. Commonly known as curly pond weed, this attractive species has a long stem (up to 200 cm long) which is profusely branched. The stem is covered with sessile leaves (2-6 cm long and 05-1 cm broad) which are curly and translucent. The leaf colour may vary from emerald green to reddish. It inhabits in standing water as well as the gently flowing waters with a thick layer of fine mud. It can grow in very hard water with a pH of around 9. The water should be rich in organic and inorganic compounds. In aquarium conditions the leaf may be more flat than crispate. This plant thrives well in both aquarium and garden ponds. It will survive in winter as long as they are lying below the ice levels of the water. Turions or winter buds will develop in large numbers on the leaf axes and the branch tips during autumn on the mother plant. As the mother plant matures, these winterbuds will fall on the mud where they can tide over the winter months followed by the commencement of growth in new season.

Potamogeton gayi

WP193 WP422 WO193
pH: 7-8.5 18-26
medium hard 4
S. America producing runners
Propagated from cuttings and runners

This plant is a native of South America. It has branching stems which produces only submersed leaves. The leaves are narrow (5-10 cm long and 0.5-0.9 cm broad), olive green to reddish brown with a pointed tip. A fast growing species producing runners. Regular pruning is necessary to keep this plant from overtaking the other plants. They can grow in any kind of substrate, rich or poor in nutrients. Planting should be done in-groups in the background of the tank.

Potamogeton malaianus

WP438 WO438

pH: 6.5-7.8 18-27

soft-hard 4

Asia, S.America

producing runners

Propagated from cuttings and runners

This species grows in abundance in the tropical and subtropical water bodies of Central and South America and Asia. The submersed leaves are membranous, light green, linearly elliptical and its strong mid rib tapers clearly in to a point. The leaves are 5-7.5 cm long and about 2 cm broad. This is the most suitable *Potamogeton* species for tropical aquariums. It is an undemanding species with respect to the composition of the substrate and water. They are good plants for background and are also suitable for garden ponds.

Potamogeton octandrus

WP1157 WO1157

pH: 6.5-7.2 18-27

soft-medium 4

Tropical Africa, Asia

producing runners

Propagated from cuttings and runners

A narrow leafed species from this genus and is commonly found in Tropical Africa and Asia. The linear submerged leaves are arranged opposite on a slender stem. The pale to mid green leaves are up to 8 cm long and about 0.1 cm broad. They are about 1.5 - 3cm long and 0.4 - 1 cm broad. The spike inflorescence usually develops on the axis of the floating leaf. Once established in the aquarium, this plant will branch out quickly and form an entangled mass of branched shoots. Thinning is to be done very often to maintain its proper shape. As it grows quickly to water surface, it should be planted in the background.

Potamogeton perfoliatus

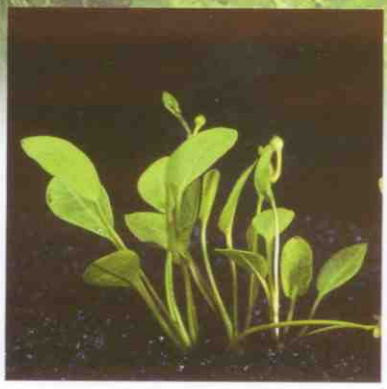
WP529 WO529

pH: 7-8.5 18-26

medium hard 4

producing runners Propagated from cuttings and runners

Found in the temperate zones of the northern hemisphere, some parts of South East Asia and Africa. This species inhabits in the brackish waters of the U.S.A; often found on sandy bottom. The submerged leaves have its base enclosed in membranous sheaths. The leaves are elliptical to heart shaped with a cordate base and up to 5 cm long and up to 3.5 cm broad. The leaves are pale green with tinges of brown and with gently undulating margins. Pruning is necessary due to the prolific development of runners. As they can withstand winter, it is also a suitable plant for ponds in temperate countries.



Ranalisma rostrata

WP750 WO750

pH: 6.5-7 22-28

soft-medium 2

Malaysia

Propagated from runners

This plant from Malaysia was formerly considered as a species of *Echinodorus*. Emergent green leaves are oval to circular, 4-6cm long and about 1cm broad. Submerged plants develop narrow linear leaves with tapering ends. They are light green in colour. It can produce a lot of runners when grown underwater like *E. tenellus*. However its usefulness as a carpet plant in the aquarium is not fully evaluated, as it is really demanding.

Genus RANALISMA
Family ALISMATACEAE

The genus *Ranalisma* consists of only 2 species, *R.humilie* from West Africa and *R. rostrata* from South East Asia. The African species is smaller than that of South East Asian counterpart. Emergent leaves are spathulate while submersed ones are linear. They often colonise the rice fields in its natural habitat.

Rorippa aquatica

WP195 WP310 WO195

pH: 7-7.5 20-25

medium hard-hard 2

USA

Propagated from seeds and leaf division

Genus RORIPPA
Family BRASSICACEAE

This genus is represented by 70 species. *R. aquatica* from U.S.A is the commonly cultivated species of this genus. This plant is considered as the most beautiful aquatic plant of the family Brassicaceae.

The young plant has leaves in rosettes which are deeply incised. Emergence of the stem coincides with flowering. The leaves borne by the stem are alternate; the lower part of the stem bears deeply incised leaves while the upper ones are entire. The submersed leaves are ribbon shaped with finely serrated margins and bright green in colour. The submersed plant does not hibernate during winter and will exhibit exceptional growth. It cannot grow in very soft water.

Genus ROTALA
Family LYTHRACEAE

This genus has its representatives, about 50 species all over the world. Many of them are true weeds in paddy fields and irrigation canals. However, this genus contains some beautiful species of aquarium plants with aesthetically coloured leaves.

Rotala indica

WP196 WP372
WO196 WP643
pH: 5.8-7 22-26
soft 3
Asia
Propagated from cuttings

In aquarium literature this plant is incorrectly named as *R. rotundifolia*. It is a native of Asia, later naturalised in the paddy fields of Italy. They have a horizontal creeping stem on wet soil. The dark green aerial leaves are spathulate and 0.5-1 cm long and 0.3-0.5 cm broad. They bear pink flowers on the axes of the leaves. Submerged leaves are spathulate, light green on upper surface and whitish green below. They prefer slightly acidic water.

Rotala macrandra

WP549 WP340 WO549
WP197 WP373 WO197
pH: 6-7 22-28
soft-medium hard 3
India
Propagated from cuttings

The rich colour of this light loving species makes it very popular among hobbyists. The submerged leaves (up to 3 cm long and 1.5 cm broad) are elliptical or egg shaped. They are longer and wider that those of *R. rotundifolia* and are pale green on upper side and red to pinkish on the underside. However, in presence of strong light the whole leaf turns bright red.

Rotala macranda 'Green'

WP877 WP981 WO877

pH: 6-7 22-28

soft-medium hard 3

India

Propagated from cuttings

The egg shaped leaves of *R. macrandra* 'Green' remains light green on top and pink at the bottom even under brightly lit conditions.

Rotala macranda
'Green Narrow Leaf'

WP890 WP980 WO890

pH: 6-7 22-28

soft-medium hard 3

Cultivar

Propagated from cuttings

The leaves of this species are notably green, especially for the older ones.

Rotala macrandra
'Narrow Leaf'

WP547 WO547

pH: 6-7 22-28

soft-medium hard 3

Cultivar

Propagated from cuttings

R. macrandra 'Narrow Leaf' has narrowly lanceolate reddish brown leaves (2-3 cm long and about 0.8 cm broad) with circular base.

Rotala macrandra
'Variegated'

WP521 WO521

pH: 6-7 22-28

soft-medium hard 3

Cultivar

Propagated from cuttings

R. macrandra 'Variegated' has leaves (size of the leaf is similar to that of *R. macrandra*) with conspicuous yellow veins on red leaf blade.

Rotala mexicana

pH: 6.5-6.8 24-28

soft-medium 3

Australia

Propagated from cuttings

2 more species from the genus, *Rotala*,such as *R.occultifolia (or R. occultflora?)*from Asia and *R. mexicana* originally from Mexico are recently introduced into aquarium hobby. These small shrubs have leaves arranged in whorls of 3- 4 when grown submerged. The leaves are linear and about 2- 3cm long and about 0.1- 0.2cm broad. They are yellowish green on top and silvery white below *(R.occultfolia)* or brownish red to deep maroon *(R.mexicana)* depending upon the light condition. They are demanding plants requiring good water condition. They can be grown in bunches in mid-ground.

Rotala occultifolia

pH: 6.5-6.8 24-28

soft-medium 3

Australia

Propagated from cuttings

Rotala najean

WP742 WP616 WO742

pH: 6.2-7 22-28

soft

3 unknown

Propagated from cuttings

Rotala rotundifolia

WP196 WP372

WO196 WP643

pH: 5.8-7 22-26

soft 4

S. E. Asia

Propagated from cuttings

It comes from South East Asia. Like *R. indica*, it has a trailing stem on wet soil or erect in submerged conditions. The submerged leaves are lanceolate or elliptical, 1-2 cm long and 0.2-0.4 cm broad and pale green to brownish red depending upon the light conditions. *R. rotundifolia* differs from *R. indica* with respect to flower arrangement. The former bears groups of terminal inflorescence while the latter has solitary flowers on the axis of leaves. Aerial leaves are round and dark green. They prefer medium-soft acidic water and bright light for its luxurious growth in the aquarium.

Rotala rotundifolia 'Green'

WP543 WO543

pH: 5.8-7 22-26

soft 3

East Asia

Propagated from cuttings

R. rotundifolia 'Green' is another form of *R. rotundifolia*. The leaves of this plant are light green and narrower and about 1 cm long. All other characters such as floral characters and position of inflorescence are similar to that of *R. rotundifolia*.

Rotala wallichii 'Long Leaf'

WP897 WO897

pH: 5-7 20-26

soft-medium hard

4

Propagated from cuttings

Rotala wallichii

WP198 WP374

WO198 WP353

pH: 5-7 20-26

soft-medium hard 4

unknown

Propagated from cuttings

This elegant plant from South East Asia is one of the most beautiful aquarium plant. The submersed leaves are filamentous, arranged in whorls of 6-9 and 1.5 cm long and less than 0.1 cm broad. The leaves are brownish green to bright red. *R. wallichii* 'Long Leaf' has similarly arranged leaves on its stem but slightly longer than the former one and more adaptable to aquarium conditions. Under strong light the shoot tip of these plant species turns bright red.

Genus SAGITTARIA
Family ALISMATACEAE

The 30 odd species belonging to this genus are commonly known as arrowhead. They have tuberous rhizome which remain buried in the soil. In Western Australia, one species, *S. graminea,* introduced by hobbyists is now naturalised in the irrigation canals and drainage ditches.

Sagittaria platyphylla

WP200 WP419 WO200
WP199 WP289 WO199
pH: 5.5-8 19-26
soft-medium 3
N. America producing runners
Propagated from runners

It is found in South of North America. The submersed leaves (in rosettes) are linear with tapering tips, grassy green and 20-30 cm long and 2- 2.5 cm broad. They often throw out aerial leaves which are broadly lanceolate or oval. A strong feeder and requires rich substrate. It can be used as background plants in quantity or as a nice centre piece of 2-3 individuals.

Sagittaria subulata

WP203 WP423 WO203
WP202 WO202
pH: 5.5-8 19-26
soft-medium 3
N. America producing runners
Propagated from runners

This species is distributed in the Atlantic coast of North America. An undemanding species that will form dense strands. The leaves are in rosettes, grass like and bright green in colour. They are 5-10 cm long and about 0.5 cm broad. This plant can thrive well over a wide temperature range. It is suitable for foreground planting.

Samolus parviflorus

WP241 WP247 WO241

pH: 6.5-7.2 20-24

soft 2

Europe

Propagated from seeds

Genus SAMOLUS
Family PRIMULACEAE

Members of this genus are commonly known as water roses and are amphibious in nature. There are approximately 25 species in this genus, and are distributed world wide.

Samolus parviflorus has leaves in rosettes. The whole plant resembles a miniature cabbage; hence the common name is water cabbage. The leaves are spathulate (tongue shaped) and about 10 cm long and 5 cm broad. The bright green leaves can bring a nice contrast and can be planted as in-groups in foreground to midground. Unfortunately this plant is very fragile and difficult to acclimatise. Additional CO_2 injection combined with strong light and low temperature (20-24 ^{o}C) can promote growth.

Saururus cernuus

WP205 WP262 WO205

pH: 6-7.2 18-24

soft-medium hard 3

USA

Propagated from cuttings

Genus SAURURUS
Family SAURURACEAE

They are herbaceous plants having a subterranean rhizome and can grow up to 1 m in height.

S. cernuus (lizard's tail), a native of North America, is a perennial bog plant with a robust rhizome. The erect stems (02-0.8 cm thick) bear heart shaped leaves which are alternate and up to 15 cm long and 8 cm broad. The hairy young leaves become smooth and glossy as they mature. Leaf colour varies from light to dark green. *S. chinensis* a wetland species from Japan and China, can reach 50-100 cm in height. The alternate leaves are dark green, elliptical with cordate base and 1.2-8 cm long and 3-5 cm broad. This plant can do well under bright illumination in a tank deeper than 50 cm and it often grows out of the water surface. It can be massed among *Cryptocorynes* or in-groups in the middle ground. A very hardy plants suitable for terrariums and garden ponds.

Genus SHINNERSIA
Family ASTERACEAE

S. rivularis (syn: *Trichocoronis rivularis*) is a native of Mexico. The leaves of these plants bear great resemblance to the Oak foliage, hence they are commonly called Mexican Oak Leaf Plant. A herbaceous plant with trailing stem when grown as emersed but erect when they are grown submerged. The leaves are opposite, light to dark green with dentate margins. Another form, *S. rivularis* 'Variegatus' produces leaves with creamy white veins on green leaf blade. These are very adaptable to aquarium conditions and can provide a refreshing contrast (due to the presence of toothed foliage) to other foliage in mid-ground to background settings in-groups. Under low light conditions the plant becomes splindly as the distance between internodes lengthens.

Shinnersia rivularis
Trichocoronis rivularis
WP358 WO358
pH: 5.8-9 20-28
soft-hard 3
Mexico
Propagated from cuttings

Shinnersia rivularis 'Variegatus'
Trichocoronis rivularis 'Variegatus'
WP528 WO528
pH: 5.8-9 20-28
soft-hard 3
Mexico
Propagated from cuttings

Genus TONINA
Family ERIOCAULONACEAE

Although the family *Eriocaulonaceae* contains very beautiful aquatic plants, they are not popular among hobbyists. This could be because these plants are very demanding, and its cultivation in the aquarium is rather difficult. Two interesting genera of this family are *Eriocaulon* and *Tonina* and both have its representatives in the aquatic world.

Tonina fluviatilis
WP1041
pH: 4-7 20-30
soft 3
S. America
Propagated from cuttings

T. fluviatilis is an amphibious plants from South America, inhabiting in the shallow waters or along the banks of slow flowing rivers. The narrow stalk (about 0.2 cm in thickness) bears oblong shaped leaves which are slender and less than 2 cm long. The leaves are bright green and translucent, and can give very good contrast in the presence of dark green plants. This plant grows up to 20 cm in height in submerged conditions and 8-10 cm when grown emerse. Another species, *Tonina sp.* has leaves arranged in whorls of 4-5 which are longer (up to 5 cm long) than that of *T. fluviatilis*. The leaves of this species are bright green, narrowly lanceolate with tapering tips.

Both of these species are difficult plants to grow in normal aquarium conditions. They require very soft water with sandy bottom mixed with peat. Water should be slightly acidic. They are quite elegant plants and can be appreciated when they are set in mid-ground in-groups.

Tonina species
WP1040
pH: 4-7 20-30
soft 3
S. America
Propagated from cuttings

Genus VALLISNERIA
Family HYDROCHARITACEAE

The members of this genus are widely spread out in tropical and subtropical regions with a few in the temperate zones. These true aquatic plants have long linear leaves in rosettes that are either coiled or flat. The flowers are unisexual (male flowers and female flowers are separate) and are not carried by the same plant, hence they are dioecious. All the species of *Vallisneria* are capable of producing runners. Depending upon the size, they can be planted in the background or on the sides of an aquarium and soon from a curtain of green vegetation.

A lot of ambiguity exists over the species' name as many botanical names are used for the same species (different varieties?) without any basis. This may be due to the collection of the same species from different location by different people. For example, the species, *V. americana* embraces the other names such as *V. asiatica, V. neotropicalis* and *V. gigantea*, and they are now considered to be the probable synonyms of *V. americana*.

***Vallisneria americana* var. americana 'Marmor'**

WP1101 WO1101
pH: 6.5-8 20-26
soft-hard 5
Cultivar
producing runners
Propagated from runners

A mutant of *V. americana* var. americana 'Rubra' discovered by Oriental Aquarium, Singapore, which has beautiful brown streaks on the leaves.

***Vallisneria americana* var. americana**

WP226 WO226
pH: 6.5-8 20-26
soft-hard 5
China, Indonesia, Philippines
producing runners
Propagated from runners

This species is distributed in North and Middle America, Japan and East Asia. The olive green leaves are more than 2m long and 1.5- 3cm broad with saw toothed tips.The flat leaves of this species 5-9 red or reddish brown veins, running parallel along the entire leaf laminae. The leaf blade has many pigmented transverse striations.

***Vallisneria americana* var. americana 'Rubra'**

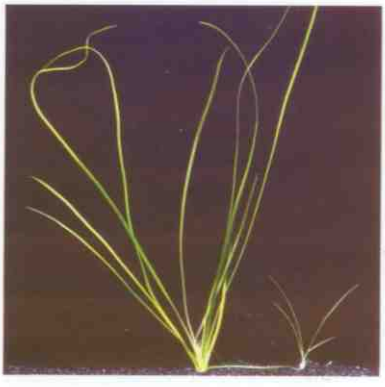
WP220 WO220
pH: 6.5-8 20-26 soft-medium
5 producing runners
Propagated from runners

Another form of *V. americana* var americana has leaves that are reddish Brown with distinct dark veins.

Vallisneria americana var. americana 'Rubra Serpenta'

WP894 WO894
pH: 6.5-8 20-26
soft-medium 5
Cultivar producing runners
Propagated from runners

At Oriental Aquarium, Singapore, a natural variant, *V. americana* var. americana '*Rubra Sepenta*' was obtained from the cultivation tank of *V. americana* var. americana. The entire leaf lamina except the edges is undulating and this distinct nature makes them more attractive.



Vallisneria americana var. natans

V. natans
WP1048
pH: 6-9 18-28
soft-hard 5
Australia
producing runners
Propagated from runners

A South Asian variety of *V. americana* . The light green leaves are 30-80 cm long and 0.5-0.8 cm broad. They are narrow with saw toothed tips. This plant can be grown in tanks and are quite hardy. A good plant for beginners.

Vallisneria americana var. biwaensis

V. asiatica var. biwaensis,
V. gigantia var. biwaensis,
V. natans var. biwaensis
WP216 WP427 WO216
pH: 6-8 20-28
soft-hard 5
Tropics
producing runners
Propagated from runners

Generally known as twisted Vallisneria. This plant is a native of Haiti, Venezuela and Japan. It has beautiful twisted leaves that are bright green, 5-50 cm long (depending upon the depth of water) and 0.3-0.5 cm broad. They are ideal for the mid-ground decoration of the tank.

Vallisneria caulescens

WP1102

pH: 6-9 18-28

soft-hard 5

Australia

producing runners

Propagated from runners

V. caulescens from Australia is a recent addition to the hobby. This species differs from the other Vallisneria species with its leaf arrangement. The leaves of this plant are arranged alternately on a long stem while the other species display rosette arrangement on a short stem. Leaves with clasping base are brown to deep maroon depending on the conditions and up to 10 cm long. However, under low light conditions, the attractively striated leaves are light green in colour and much longer. The flowers develop on the axes of the leaves.

Vallisneria spiralis

WP221 WP486 WO221

pH: 6-9 15-30

soft-hard 5

producing runners

Propagated from runners

This species is widely distributed in the tropics, subtropics and sometimes in the temperate zone (Italy and France); especially in the subtropical region of North Africa. The leaves are usually 20-80 cm long, but sometimes more than 1m and about 1 cm broad. The leaves are straight when plants are young. Long leaves will coil once or thrice along their length. The female flowers usually appear on tightly coiled floral stalk, from which the plant derives its name, *V. spiralis.*

Vallisneria spiralis 'Leopard'

WP538 WO538 WP694

pH: 6-9 15-30

soft-hard 5

unknown

producing runners

Propagated from runners

V. spiralis 'Leopard' has striped leaves that are linear, up to 70cm long and about 0.5cm broad.

Vallisneria spiralis 'Tortifolia'

WP218 WP299 WO218

pH: 6-9 20-30

soft-hard 5

unknown

producing runners

Propagated from runners

Commonly known as Water Corkscrew. *V. spiralis* 'Tortifolia' produces much broader leaves (about 1.2cm) than any other Forms of *V. spiralis*. The leaves are 30-40cm long and coiled many times but lesser than that of *V.spiralis var. contortionist.*

Vallisneria spiralis var. contortionist

WP217 WO217

pH: 6-9 20-30

soft-hard 5

unknown

producing runners

Propagated from runners

Depending upon the leaf size, state of the leaf lamina (less or more coiled) and the colour, they are subdivided in to , *V. spiralis* var. contortionist(Corkscrew Vallisneria) with tightly spiraled leaves as many as 25 times, *V. spiralis* 'Red' with reddish green leaves, *V. spirallis* 'Leopard' with striped leaves and *V. spiralis* 'Tortifolia' with less tightly spiraled leaves.

All these species can grow on sandy bottom. They can grow in any type of water without showing any stress. However, *V. spiralis* var. contortionist needs higher temperature (above 20 °C) than the other types.

Floating Plants

This is a rather loose classification than purely scientific, and the plants may be non-flowering or flowering. This kind of grouping helps novice to identify the plants according to the requirements. The plants belonging to this group have leaves that are floating. Many of them have well developed root systems suspended in the water column. Generally the long stemmed floating plants have lateral stems (stolons) growing on or above ground, which can develop roots at the nodes. The short-stemmed ones have floating leaves in rosettes. Despite the presence of anchored upright stem, *Ludwigia sediodes* is considered as a floating plant as it can only produce floating leaves.

Aeschynomene fluitans
WP1024
pH: 6-7.5 22-30
soft-hard
Africa
Floating plant with spongy stem
Propagated from seeds and cuttings

Genus AESCHYNOMENE
Family FABACEAE

This species is native of Okavango in Africa, where it creeps on the water surface. The floating stem bears pinnately compound leaves which are alternate and sensitive to touch, but the reaction is slow. They produce yellow showy flowers (butterfly-like), typical for the species belonging to this family. It is generally known as the 'Giant Sensitive Fern' even though it is not a member of fern family. As they can grow very large, this plant is only suitable for large display tanks and also for decorating garden ponds.

Azolla caroliniana
WP449
pH: 6-8 15-30
soft-hard
Cosmopolitan
Floating fern with nitrogen fixing capability
requiring more than 12 hours' photoperiod for robust growth
Propagation by spontaneous division

Genus AZOLLA
Family AZOLLACEAE

Azolla is a minute fern found in water bodies as a floating plant or growing on moist medium as land forms. *A. caroliniana* was originally from subtropical America but later introduced to Europe. A very small plant with tiny scale like leaves often reddish or green in colour with red margins. The hairy leaves are borne on small branched stem. It is not suitable for the aquarium as it forms a floating cover and prevents the other plants from receiving light. It is more suitable for terrariums where it can grow on moist soil and form a red green velvety carpet.

Genus CERATOPTERIS
Family PTERIDACEAE

C. pteroides from Asia and America is more or less a floating plant, but it can root in very shallow waters. The leaves are in rosettes of 4-6. The leaf blade is lance-shaped or heart shaped and lobed or sometimes whole with toothed margin. Young plants often develop on the margin or on the rib of the leaf blade. The profusely branched roots are a good hiding place for fry and also a spawning place for many fishes. They prefer soft acidic water.

Ceratopteris pteroides
WP508
pH: 5.5- 6.8 18-30
soft-medium hard
Tropics
Floating fern
Propagated from adventitious plantlets on matured leaves

Genus EICHHORNIA
Family PONTEDERIACEAE

Presently this species, *E. crassipes*, is almost globally distributed due to its invasion in water bodies after having been introduced from Africa, its natural habitat. A floating plant with spathulate leaves borne on a swollen petiole. The inflated spongy tissue of the petiole enables the plant to float. It has a robust root system that forms a tangled mass, sometime as long as 20 cm. This plant bears beautiful blossoms which resembles that of a hyacinth, hence the name water hyacinth. It is suitable for large aquariums and indoor ponds. It is also a very good biological filter and can remove the excess nutrients from the water.

Eichhornia crassipes
WP117
pH: 5.5-9 15-30
soft-hard
Cosmopolitan
Propagated from the runners
Floating plant which can act as a nutrient sponge

Hydrocharis dubia
WP1028
pH: 6-7.5 22-28
soft-hard
Asia, Australia
Floating or rooted plant with stolons
Propagated by the division of stolons

Genus HYDROCHARIS
Family HYDROCHARITACEAE

H. dubia, a native of Asia and Australia, is a stoloniferous perennial with floating leaves and flowers. The stolons root at the bottom in shallow waters, but will float across in the deeper water by hanging the roots down. The pale green leaf laminae are circular with rounded basal lobes and are up to 7 cm in diameter. The unisexual flowers have white petals with yellow base. They develop winter buds to tide over the adverse winter conditions and the young plants will develop from them at the advent of spring. This plant is more suitable for ponds as it soon forms a dense cover of floating leaves and casts too much shade.

Hydrocleis nymphaeoides
WP393 WO393
pH: 6-7.5 22-28
soft-hard
S. America
Floating or rooted plant with stolons
Propagated by the division of stolons

Genus HYDROCLEIS
Family BUTOMACEAE

The genus *Hydrocleis* includes 9 species. *H. nymphaeoides* is a native of tropical South America and is often cultivated in the aquatic green house in botanical gardens along with gigantic water lilies like *Victoria regia* and *V. cruziana*. The floating leaves of this perennial water plant are glossy and leathery with a long petiole. The heart shaped or egg shaped leaf blade are dark green, 10 cm in length and 7 cm in breadth. The stolon (lateral stem growing on or above the ground) is profusely branched and about 1m long with many shoots. The glowing beautiful yellow blossoms can add beauty to most aquariums. It thrives well in a substrate rich in humus.

Genus HYGRORHYZA
Family POACEAE

The species *H. aristata* is of South Asian origin where it grows in swamps, wetlands and shallow waters. The creeping rhizome develops the floating shoots which grow from edges to the middle of water bodies in its habitat. The leaves are opposite, lance- shaped and dark green. The petiole is enveloped in a membranous sheath along its entire length. This is the only grass species being used in aquarium. The roots develop from the rhizome (at the base of the shoots) is a good hiding place for fishes. This plant is suitable for open aquarium.

Hygrorhyza aristata
WP394
pH: 6-8 22-28
soft-hard
S. Asia
Plant with floating shoots and leaves
Propagated from cuttings

Genus LIMNOBIUM
Family HYDROCHARITACEAE

L. laevigatum a perennial floating plant from the warmer parts of South America has hairy floating leaves close to each other with very short petioles. The leaf blade is fleshy, circular, but lobular at the base and deep green on the upperside and violet with brown spots on the lowerside. The lowerside of the leaf blade has spongy tissue (almost like a pad) which enable them to float on the water surface. *L. spongia*, a species from North America, has loosely arranged leaves which are egg to heart shaped and about 10 cm long. The leaf blade is midgreen on both sides. *L. laevigatum,* an attractive floating plant with its delicate root system, is suitable for well-lit aquarium.

Limnobium laevigatum
WP136
pH: 6.5-7.5 20-30
soft-medium hard
S. America
with only floating leaves
Propagated from runners

Ludwigia sedioides

WP396

pH: 6-7.2 20-30

soft-medium hard

S. America

with floating leaves

Propagated from cuttings

Genus LUDWIGIA
Family ONAGRACEAE

This novelty, *L. sedioides*, is from South America. It has a creeping stem from which shoots will emerge. The leaves are arranged in pseudo whorls and the gap between the pseudo whorls gets narrower as the shoots reach the water surface, hence giving the impression that the leaves are in dense rosettes. The floating leaves are diamond shaped with serrated margins at the upper halves while the lower halves are not serrated. The young leaves are yellowish green with reddish petioles. As the leaves grow, the petioles elongate, hence the old purple red leaf blades remain floating on the water surface. They produce yellow flowers with four petals. This elegant species prefers mildly acidic water and strong lighting.

Nymphoides indica

WP436

pH: 6.5-7.2 20-28

soft-medium hard

Tropics

Plant with floating leaves and stolons

Propagated by the division of stolons

Genus NYMPHOIDES
Family GENTIACEAE

N. indica from the tropics, *N. crenata* from Australia, and, *N. peltata* from Europe are three *Nymphoides* species other than the banana plant *(N. aquatica)* usually found in an aquarium. The species, *N. crenata* and *N. indica* are robust perennials with long petiole floating leaves and floating stolons up to 2 m long. *N. indica, N. crenata and N. peltatum* are cultivated in the aquarium for their attractive floating leaves and flowers while *N. aquatica* for its unique banana like tubers. The floating leaves are kidney shaped, dark green and 5-20 cm broad (*N. indica*) or almost circular leaves with crenate (notched) margins having burgundy green blotches on the leaf laminae (*N. crenata*). *N. peltatum* produces crenate leaves but are light green in colour. *N. indica* produces white flowers with white fringed petals while *N. crenata* and *N. peltata* have flowers with yellow fringed petals, but the latter lacks a median fringed wing on the yellow petal. These plants require humid air above the water. They are generally recommended for large tanks or garden ponds.

Nymphoides peltata

WP1009

pH: 6.5-7.2 20-28

soft-medium hard

Europe

Plant with floating leaves and stolons

Propagated from the division of stolons

Genus PISTIA
Family ARACEAE

P. stratiotes (water lettuce) is a dominating aquatic species throughout the tropics and also occasionally found in subtropics. The leaves arranged in rosettes on a short axis are very variable; tongue shaped, wedge shaped or round. They are bright green on upper side and whitish green on the lower side and sparsely haired. This plant develops a dense network of rooting system, up to 20 cm long and is useful as a spawning medium. Light is very critical to sustain growth throughout the year. It will hibernate in aquariums if the light period is less than 12 hours a day. A true floating plant that can be kept in large tanks and also in ponds.

Pista stratiotes

WP192

pH: 6.5-7.2 20-28

soft-hard

Tropics

Floating plant producing runners

Propagated from runners

Salvinia natans
WP204
pH: 6-8 18-30
soft-hard
Cosmopolitan
Floating fern
Propagated from fragmented shoots

Genus SALVINIA
Family SALVINIACEAE

S. natans is distributed in the warmer parts of Europe and in eastern Asia. It is a free floating aquatic fern with whorls of 3 leaves, 2 floating and one submerged. The floating leaves are elliptical to ovate and up to 2 cm long. They are light green in colour with dense stiff hairs on the upper surface. The submerged leaves are finely dissected and serve as nutrient absorbing organs. A fast multiplier hence, frequent culling is necessary.

S. oblongifolia from Amazon region is larger than any other *Salvinias*. As the name suggests, the floating leaves are oblong to circular covered with silk hairs up to 0.5 cm long and about 2 cm broad. It can spread fast under brightly lit conditions. As this plant can grow on moist soil, it can be a good addition to terrariums.

Salvinia oblongifolia
WP1025
pH: 6-8 18-30
soft-hard
S. America
Floating fern
Propagated from fragmented shoots

Genus TRAPA
Family TRAPACEAE

The water chestnut, as it is often called, is distributed throughout the world. This annual plant produces linear submerged leaves as well as rosettes of floating leaves up to 50 cm in diameter. The blades borne on reddish petioles (dilated in the middle) are rhomboidal and sharply dendate in front. The leaves are light green and glossy on the upper side. This plant can beautify the garden ponds, where it can blossom and bear chestnut like fruits.

Trapa natans
WP214 WP248
pH: 6-7.2 18-28
soft
Cosmopolitan
Floating plant with leaves in rosettes
Propagated from seeds

Genus UTRICULARIA
Family LENTIBULARIACEAE

A large genus, comprising about 260 species, is mainly distributed in the tropics. *U. aurea* is an attractive species and can be used to decorate the aquarium. The slender stem can reach 70 cm with leaves divided in to fine segments are light green to yellow green in colour. They have specialised bladder like organs to catch plankton. It produces yellow flowers borne by long stalks above the water surface (rarely in aquarium). This floating species is very hardy and can grow in a wide range of aquarium conditions.

Utricularia species
WP215 WO215
pH: 5-8 18-30
soft-hard
Tropics
without roots
Propagated from dividing shoots
Sometimes a nuisance to the aquarium

Terrarium Plants

This group comprises assorted plants from both flowering and non-flowering types. Plants under this category are generally "moist-loving". They cannot tolerate very wet or fully submerged conditions. As these plants prefer damp conditions for their robust growth, they are good candidates for decorating terrariums and pond edges.

Genus ACORUS
Family ARORACEAE

Acorus are generally found in cold temperate zones, but some species are also found in sub-tropical areas; for example *A. calamus* var. angustifolius.

These plants have horizontal rhizomes with narrow bright green pointed leaves which spread like a fan. *A. gramineus* var. gramineus has leaves reaching 30 cm long and 1cm broad. However, *A. gramineus* var. pusillus has shorter leaves of up to 10cm long. *A. gramineus* var. pusillus 'Broad Leaf' has leaves 4-6 cm broad.

These plants do well at temperatures of around 22 °C. They are not true aquatic plants and generally recommended for terrariums.

***Acorus gramineus* var. pusillus**

WP002 WP251 WO002

18-28

Propagated by division of the rhizomes

***Acorus gramineus* var. variegatus**

WP004 WP245 WO004

18-28

A. gramineus var. variegatus has leaves that are yellow-striped.

Genus AGLAONEMA
Family ARACEAE

The genus, *Aglaonema*, was originally found in Malaysia and Philippines.

Height of this genus varies from 30-90 cm depending on the species. The lance leaf blade is dark green and waxy (*A. simplex*) or with silvery markings along the veins (*A. commutatum* var. 'Silver Queen') or narrow and long (*A. sp* 'Narrow Leaf').

They are suitable as marginal plants, grown at the edge of ponds where its root system can absorb nutrients from the water while its foliage remains above the water. These true shade loving plants are suitable for terrariums.

Aglaonema 'Silver Queen'

WP550 WP420

22-28

Propagated by division of the rhizomes

Aglaonema simplex

WP005 WP274 WO005

22-28

Propagated by division of the rhizomes

Genus ALTHERNANTHERA
Family AMARANTHACEAE

Many species of this genus are suitable for the aquarium. However, *A. ficoidea* 'Bettzickiana' from Brazil is non aquatic. These bushy plants do not grow more than 15 cm and are available in three different colours. The ruffled leaves are light green (*A. ficoidea* 'Bettzickiana Aurea'), green (*A. ficoidea* 'Bettzickiana Green') or red / bronze (*A. ficoidea* 'Bettzickiana Red'). A narrow leafed form, *A. ficoidea* 'Bettzickiana Red Narrow Leaf' is also available now. As terrarium plants, they produce very effective colour contrast.

Alternanthera ficoidea
'Bettzickiana Aurea'
WP412 WP284 WO412
24-30
Propagated from cuttings

Alternanthera ficoidea
'Bettzickiana Green'
WP272 WP813 WO272
24-30
Propagated from cuttings

Alternanthera ficoidea
'Bettzickiana Red'
WP013 WP334 WO013
24-30
Propagated from cuttings

Alternanthera spieces 'Red Round'

WP558 WP658 WO558

24-30

Propagated from cuttings

Bacopa lanigera

WP366 WO366

20-26

Propagated from cuttings

Genus BACOPA
Family SCROPHULARIACEAE

Unlike other *Bacopa* species, this Brazilian species, *B. lanigera*, is more suitable for the terrarium. It has an erect hairy stem with opposite leaves. The leaves are short petioled (almost sessile) of about 3 cm long and 2.5 cm broad. The bright green leaf blade has conspicuous cream coloured veins.

Genus CALADIUM
Family ARACEAE

Originated in Peru and Brazil, the members of this genus are tropical perennials with tuberous roots and arrow shaped leaves. *C. bicolor* var. 'Frieda Hemple' is about 45 cm in height and has papery leaves which are patterned and blotched beautifully in red. The miniature form, *C. humboldtii* can grow to about 25 cm in height and has leaves mottled with white patches.

These plants do well in warm shade and cannot be kept submerged for a long period. They are ideal for terrariums.

Caladium bicolor var.
'Frieda Hemple'
WP356
22-30
Propagated by division of tubers

Caladium humboldtii
WP060 WP279
22-30
Propagated by division of tubers

Calamus sp. 'Bamboo Plant'

WP133 WO133

22-28

with climbing habit

Propagated from seeds

Genus CALAMUS
Family PALMAE

This genus has its origin in S E Asia.

It includes climbing rain forest feather palms armed with prickly stems. The two species commonly known as 'Bamboo Plant' with palmately compound leaves and 'Coconut Plant' with pinnately compound leaves are cultivated in the terrarium because of its slow growth at the beginning. These plants look very attractive and can produce lush green forest effect when they are young.

Chamaedorea elegans

WP490

22-28

Propagated from seeds

Genus CHAMAEDOREA
Family PALMAE

This genus is native to Southern Mexico and Guatemala.

This solitary stemmed palm, *C. elegans* will flower when it is more than 30 cm in height. Even though they can grow up to 2 m tall in its natural habitat, this slow growing species can be kept in a terrarium. The crown is compact with pinnately compound leaves with no visible stem when it has its first blossoms.

A beautiful plant which enhances the natural look of any terrarium.

Genus CHLOROPHYTUM
Family LILIACEAE

C. bichetii is native to Malaysia.

This plant has a rhizome that bears 20-30 strap like leaves in rosettes. The rhizome often bears bulblets. The leaves, tapering at both ends are bright green bordered with golden yellow. Even though they can adapt to submersed growth, it is only for a short period.

As a bog plant, it can be planted at the edge of the pond and they are also suitable for terrariums.

Chlorophytum bichetii

WP066 WP253 WO066

22-28

Propagated from bulbets

Genus CORDYLINE
Family LILIACEAE

Plants belonging to this genus love moisture. They are hardy with stiff tapering leaves. The foliage may be brownish green and glossy (*C. species* var. 'Compacta'); distinctly variegated or brownish green laminae with bright red edges (*C. species* var. 'Red Edge'). Regular pruning will keep the plants short.

They can be grown as marginal plants along the edge of the pond and should be kept in brightly-lit areas to maintain its vibrant colour.

Cordyline species 'Compacta'

WP364 WP336 WO364

22-30

Propagated from cuttings

Cordyline species 'Red Edge'

WP238 WP256 WO238

22-30

Propagated from cuttings

Cyperus alternifolius

WP347 WP348 WO347

17-28

with vestigial leaves

Propagated from the culms and seeds

Genus CYPERUS
Family CYPERACEAE

C. alternifolius, often known as umbrella plant, is a sedge originating from Madagascar.

The clumps of tall bare stems (30-150 cm tall) crowned with long, slender, dark green leaf like bracts. Small brown fuzzy flowers often develop from the top of the stem. *C. haspens* has clumps of bare stems (30-50 cm long) topped with stiff bracts (leaf like) and inflorescence.

As they are semi aquatic, they can be grown along the edges of pond or in terrariums by keeping its root system fully submerged.

Cyperus haspens

WP824 WP825

17-28

with vertigial leaves

Propagated from plantlets develop on inflorescence

Genus DIEFFENBACHIA
Family ARACEAE

Dieffenbachia, generally known as dumbcane, is a native of North America.

There are about 23 cultivars. They are hardy thick stemmed plants with oblong, pointed, leathery leaves. The leaves of these cultivars have striking patterns. The dark green leaf blades are often splotched with creamy white along the main veins. This spectacular leaf pattern is the basis for the varietal identification.

Despite their affinity towards bright light, they can thrive well in shaded areas. They do not like too much moisture in the rooting medium, hence should be planted in the terrarium where the soil is not soggy. The height of the plant can be checked by regular pruning.

Dieffenbachia bausei
WP098 WP277 WO098
23-30
Propagated by division of rhizome

Dieffenbachia exotica 'Variegata'
WP402
23-30
Propagated from cuttings

Dieffenbachia marianne
WP424
23-30
Propagated by division of rhizome

Dieffenbachia picta
WP463 WP354
23-30
Propagated by division of rhizome

Genus DRACAENA
Family ARACEAE

These evergreen plants from the tropics are grown for the lush effect of the foliage.

This genus exhibits great variation in leaf shape and size. *D. deremensis* has glabrous dark green leaves, while *D. deremensis* 'Striped' has lanceolate green with white longitudinal striped leaves. *D. godseffiana* is multi-stemmed (oblique) and has flat green leaves with white and yellow spots. Another variety, *D. godseffiana* var. 'Florida Beauty' has densly mottled leaves with creamy white patches. *D. marginata* var. colorama has twisted and bent stems crowned with rosettes of red edged green narrow leaves. *D. sanderiana* has white banded gray green leaves. *D. variegatus* has yellow streaked bright green blades.

All these plants can tolerate low light conditions, and can grow in wet soil.

Dracaena deremensis
WP099 WP264 WO099
22-28
Propagated from cuttings

Dracaena deremensis 'Striped'
WP484 WP1153 WO1153
22-28
Propagated from cuttings

Dracaena godseffiana
WP661
22-28
Propagated from cuttings

Dracaena godseffiana
'Florida Beauty'
WP662
22-28
Propagated from cuttings

Dracaena marginata var. colorama
WP663
22-28
Propagated from cuttings

Dracaena sanderiana
WP100 WP276 WO100
22-28
Propagated from cuttings

Dracaena variegatus
WP342 WP333 WO342
22-28
Propagated from cuttings

Fittonia argyronanta
WP302 WP381 WO302
22-27
with prostate habit
Propagated from cuttings

Genus FITTONIA
Family ACANTHACEAE

The genus *Fittonia*, a tropical creeping perennial, originates from Peru.

F. argyronanta otherwise known as nerve plants; has emerald green leaves with strikingly white veins. As they like humid environment, they usually do well in terrariums. A good plant for the terrarium. It will grow to about 15 cm in height with an indefinite spread.

Hemigraphis colorata
WP341 WP332 WO341
23-28
Propagated from cuttings

Hemigraphis colorata 'Exotica'
WP124 WP258 WO124
23-28
Propagated from cuttings

Genus HEMIGRAPHIS
Family ACANTHACEAE

These are tropical perennials mainly from Malaysia.

They are grown for its attractive foliage. The shape and size of the leaves vary. Leaves are usually grayish green stained with purple red and deep purple on the reverse side. They are either cordate with dentate margins (*H. colorata*) or elliptical with highly puckered leaf blades (*H. colorata* var. exotica). Another variety *H. colorata* var. exotica 'Narrow Leaf' has puckered leaf blades, but narrower than that of *H. colorata* var. exotica. The leaves of *H. repanda* is linearly lanceolate with toothed margins. *H. species* 'Mini' a dwarf variety of *Hemigraphis* with small egg shaped leaves which are about 2 cm long and 1.5 cm broad. Another form, *H. species* has the leaves almost similar to that of *H. species* mini, but are red in colour.

All these species are prostrate growing ones with indefinite spread. They can thrive in shaded areas, particularly in the humid environment of a terrarium.

Hemigraphis colorata
'Exotica Narrow Leaf'
WP240 WO240
23-28
Propagated from cuttings

Hemigraphis repanda
WP383 WP305 WO383
23-28
Propagated from cuttings

Hemigraphis species
WP147 WO147
23-28
Propagated from cuttings

Hemigraphis species 'Mini'
WP392 WP414 WO392
23-28
Propagated from cuttings

Genus OPHIOPOGON
Family LILIACEAE

Mondo grass or lily tuffs are natives of Japan. The attractive shiny strap like leaves provides a good ground cover by its underground stolons. The linear leaves are 60 – 100 cm long and green (*O. jaburan*) or green with creamy white stripes (*O. jaburan* 'Variegatus'). *O. japonica* (dwarf mondo grass) has slender leaves that are about 45 cm long and are dark green. The variety, *O. japonica* 'Kyoto' produces the shortest leaves that are about 12 cm long and jade green in colour. The flowers are white (*O. jaburan*) or lilac white (*O. japonica*).

As all these plants grow in the wetland in its natural habitat, they can be cultivated along the edge of the ponds or in the terrarium.

Ophiopogon jaburan
WP309 WP319 WO309
18-28
Plant with leaves in 2 rows on a compressed stem
Propagated from stolons

***Ophiopogon jaburan* 'Variegatus'**
WP322 WP282 WO322
18-28
Plant with leaves in 2 rows on a compressed stem
Propagated from stolons

***Ophiopogon japonica* 'Kyoto'**
WP365 WP386 WO365
18-28
Plant with leaves in 2 rows on a compressed stem
Propagated from stolons

Ophiopogon japonica
WP189 WP283 WO189
18-28
Plant with leaves in 2 rows on a compressed stem
Propagated from stolons

Genus PELIOSANTHES
Family LILIACEAE

A native of Thailand.

This plant is characterised with lance shaped leaves with conspicuous parallel veins. The leaf blade tapers at both ends, brownish green in colour and are gently arched especially in the older plants. It can adapt to terrarium conditions , but should be kept in the shaded areas.

Peliosanthes species

WP445

22-28

Propagated by division of rhizome

Genus SCHISMATOGLOTTIS
Family ARACEAE

This plant is from Peninsular Malaysia.

They can reach 30-60 cm in height. The leaves are elliptical with a pointed tip and cordate base. There are silvery blotches along the mid rib of the leaf laminae. The petiole is sheathed up to half from the base. The plant may bear 5-10 leaves. A typical indoor plant which can also adapt to terrarium conditions. They prefer to grow under medium light conditions in humid environment.

Schismatoglottis species

WP206 WP343 WO206

22-28

Propagated by division of rhizome

Selaginella wildenowii

WP207 WO207

20-27

A fern ally, not a true fern

Genus SELAGINELLA
Family SELAGINELLACEAE

S. wildenowii (peacock fern) is a native of Vietnam, Malaysia and the Himalayas.

This robust growing plant will be upright when young, but soon develops the tendency to climb and can reach 6 m high. The light brown stem (often supported by stilt root) bears spreading fronds of shimmering peacock blue. This plant can be used to decorate terrariums as they like humid environment.

Spathiphyllum cannaefolium

WP439 WP605

22-28

Propagated by division of rhizome

Genus SPATHIPHYLLUM
Family ARACEAE

This genus is originally found in South and Central America and South East Asia.

All species of *Spathiphyllum* have glossy green lanceolate leaves that are light green or dark green in colour. They produce spadix inflorescence. The spathe of the inflorescence is white in colour or sometimes tinged with green and curved like a spoon. *S. cannaefolium* (about 1 m tall) can grow in half submerged condition, hence, it can be cultivated along the edges of a pond. A familiar species *S. wallisii* (with clumps of growth and slightly arching leaves) can be kept submersed for 3-5 months in an aquarium without suffering much deterioration. However this plant like *S. petite* is more appropriate for the terrariums.

Spathiphyllum petite

WP545

22-28

Propagated by division of rhizome

Spathiphyllum species

WP208 WP306

22-28

Propagated by division of rhizome

Spathiphyllum wallisii

WP210 WP260

WO210 WP652

22-28

Propagated by division of rhizome

Genus SYNGONIUM
Family ARACEAE

With its natural habitat in the jungles of Central America, these are indoor ornamental plants with attractive foliage. *S. podophyllum* (goose foot plant) has leaves that are arrow shaped and light green when young which will become palmately lobed at maturity. This creeping or climbing plant is attractive when placed among the darker green plants. The leaves of *S. podophyllum* 'Red Knight' are tinged with pink which can provide a good contrast in a green background. The immature leaves of *S. species* 'White Butterfly' are 80% green while the older leaves are almost white. They are all good choices for decorating terrariums as they can provide good contrast with their colour and shape.

Syngonium podophyllum
WP211 WP261 WO211
22-28
with climbing habit
Propagated from cuttings

Syngonium podophyllum
'Red Knight'
WP441 WP480
22-28
with climbing habit
Propagated from cuttings

Syngonium species 'White Butterfly'
WP295 WP275 WO295
22-28
Leaves arranged in more or less rosettes and not climbing
Propagated from cuttings

Genus TRICHOMANES
Family HYMENOPHYLLACEAE

These ferns are mainly found in tropical lowlands and rain forests.

The taxonomy of this genus is volatile and many species are ascribed to other genera. *T. javanicum* (aqua fern) from Malaysia has erect brown stem bearing pinnately dissected leaflets. Another species, *Trichomanes sp.* generally known as Borneo fern has erect brown stems and leaflets borne by these slender stems are entire and dark green with fringed margins. These fern should be attached to wood work or rocks in the terrarium in the shaded areas to achieve the best result. The fronds of these plants are very shiny and terrariums will look more natural with the presence of these plants.

Trichomanes javanicum 'Aqua fern'
WP047 WO047
20-27 Fern
Propagated by division of rhizome

Trichomanes javanicum
'Borneo Fern'
WP048 WO048
20-27 Fern
Propagated by division of rhizome

INDEX

A

Acorus gramineus var. pusillus....160
Acorus gramineus var. variegatus....160
Aeschynomene fluitans....151
Aglaonema 'Silver Queen'....161
Aglaonema simplex....161
Alternanthera ficoidea 'Bettzickiana Aurea'....162
Alternanthera ficoidea 'Bettzickiana Green'....162
Alternanthera ficoidea 'Bettzickiana Red'....162
Alternanthera ocipus....38
Alternanthera reineckii....37
Alternanthera reineckii var. cardinalis....37
Alternanthera reineckii var. lilacina....38
Alternanthera reineckii 'Variegated'....38
Alternanthera rosaefolia....37
Alternanthera sessilis....38
Alternanthera species 'Red Round'....163
Ammannia gracilis....39
Ammannia multiflora....39
Ammannia senegalensis....39
Ammoricia aquatica....131
Anubias afzelii....40
Anubias barteri var. angustifolia....40
Anubias barteri var. barteri....41
Anubias barteri var. barteri 'Broad Leaf'....41
Anubias barteri var. barteri 'Marble'....41
Anubias barteri var. barteri 'Variegated'....42
Anubias barteri var. barteri 'Wavy'....42
Anubias barteri var. coffeefolia....42
Anubias barteri var. nana....43
Anubias barteri var. nana 'Marble'....43
Anubias barteri var. nana 'Narrowleaf'....43
Anubias barteri var. nana 'Petite'....44
Anubias barteri var. nana 'Stardust'....44
Anubias barteri var. nana 'Variegated'....44
Anubias barteri var. nana 'Wrinkled Leaf'....44
Anubias gigantea....45
Anubias gracilis....45
Anubias hastifolia....45
Anubias heterophylla....46
Anubias heterophylla 'Lancelota'....46
Anubias species 'Garbon'....46
Aponogeton boivinianus....47
Aponogeton capuronii....47
Aponogeton crispus....47
Aponogeton elongatus....48
Aponogeton longiplumulosus....48
Aponogeton madagascarensis 'Broad Leaf'....48
Aponogeton madagascarensis 'Narrow Leaf'....49
Aponogeton natans....49
Aponogeton rigidifolius....49
Aponogeton stachysporus....50
Aponogeton ulvaceus....50
Aponogeton undulatus....50
Azolla caroliniana....151

B

Bacopa amplexicaulis....51
Bacopa caroliniana....51
Bacopa caroliniana 'Variegata'....51
Bacopa lanigera....52,163
Bacopa monniera....52
Bacopa myriophylloides....52
Barclaya longifolia....53
Barclaya longifolia 'Red Form'....53
Blyxa alternifolius....54
Blyxa aubertii....54
Blyxa japonica....54
Bolbitis heteroclita....29
Bolbitis heudelotii....29

C

Caladium bicolor var. 'Frieda Hemple'....164
Caladium humboldtii....164
Calamus species 'Bamboo Plant'....165
Cabomba aquatica....55
Cabomba caroliniana....55
Cabomba juscata....55
Cabomba piauhyensis....55
Cabomba palaeformis....56
Cardamine lyrata....56
Ceratophyllum demersum....57
Ceratophyllum demersum 'Mexico'....57
Ceratopteris pteroides....152
Ceratopteris siliquosa....30
Ceratopteris thalicroides....30
Chamaedorea elegans....165
Chladophora aegagropila 'Moss Balls'....23
Chlorophytum bichetii....166
Christmas Moss 'South America'....26
Cordyline species 'Compacta'....166
Cordyline species 'Red Edge'....166
Crassula helmsii....58
Crinum calamistratum....59
Crinum natans....59
Crinum natans 'Crispus'....60
Crinum thaianum....60
Cryptocoryne affinis....61
Cryptocoryne albida....61
Cryptocoryne becketii....61
Cryptocoryne ciliata....62
Cryptocoryne cordata 'Rosa Nervis'....62
Cryptocoryne cordata var. blassii....62
Cryptocoryne cordata var. siamensis....63
Cryptocoryne crispulata....63
Cryptocoryne crsipatula var. balansae....63
Cryptocoryne griffithii....64
Cryptocoryne haerteliana....61
Cryptocoryne johorensis....64
Cryptocoryne lingua....64
Cryptocoryne longicauda....64
Cryptocoryne lucens....65
Cryptocoryne lutea....65
Cryptocoryne parva....65

Cryptocoryne petchii....65
Cryptocoryne pontederiifolia....66
Cryptocoryne pygmaea....66
Cryptocoryne retrospiralis....63
Cryptocoryne tonkinensis....66
Cryptocoryne undulata 'Red'....67
Cryptocoryne usteriana....67
Cryptocoryne walkeri....67
Cryptocoryne wendtii 'Broad Leaf'....68
Cryptocoryne wendtii 'Brown'....68
Cryptocoryne wendtii 'Green Gecko'....69
Cryptocoryne wendtii 'Chameleon'....68
Cryptocoryne wendtii 'Green'....69
Cryptocoryne wendtii 'Green' *x Tall Form*....69
Cryptocoryne wendtii 'Mi Oya'....70
Cryptocoryne wendtii 'Tropica'....70
Cryptocoryne wendtii x hybrid....70
Cryptocoryne x willisii....70
Cyperus alternifolius....167
Cyperus haspens....167
Cyperus helferi....71

D

Dieffenbachia bausei....168
Dieffenbachia exotica 'Variegata'....168
Dieffenbachia marianne....168
Dieffenbachia picta....168
Didiplis diandra....71
Dracaena deremensis....169
Dracaena deremensis 'Striped'....169
Dracaena godseffiana....169
Dracaena godseffiana 'Florida Beauty'....170
Dracaena marginata var. colorama....170
Dracaena sanderiana....170
Dracaena variegatus....170

E

Echinodorus amazonicus....72
Echinodorus angustifolius....72
Echinodorus 'Apart'....73
Echinodorus argentinensis....73
Echinodorus x barthii....74
Echinodorus berteroi....74
Echinodorus bleheri....75
Echinodorus bleheri 'Azurea'....75
Echinodorus cordifolius....75
Echinodorus cordifolius 'Marble Queen'....76
Echinodorus grandiflorus....76
Echinodorus horemanii 'Red'....77
Echinodorus 'Indian Red'....77
Echinodorus latifolius....78
Echinodorus major....78
Echinodorus macrophyllus....79
Echinodorus muricatus 'Green'....79
Echinodorus 'Oriental'....79
Echinodorus osiris....80
Echinodorus 'Ozelot'....80
Echinodorus 'Ozelot Green'....81
Echinodorus parviflorus....81
Echinodorus parviflorus 'Tropica'....82
Echinodorus peruensis....81
Echinodorus 'Phyton'....82
Echinodorus quadricostatus var. madalengensis....82
Echinodorus 'Red Flame'....83
Echinodorus 'Red Rubin'....83
Echinodorus 'Rose'....84
Echinodorus rubra....81
Echinodorus 'Rubin Narrow Leaf'....83
Echinodorus scaber....84
Echinodorus schlueteri....84
Echinodorus schlueteri 'Leopard'....85
Echinodorus species....85
Echinodorus species 'Gabrieli'....86
Echinodorus species 'Harbich'....86
Echinodorus species 'Long Leaf'....87
Echinodorus tenellus....87
Echinodorus tenellus 'Broad Leaf'....88
Echinodorus uruguayensis....88
Echinodorus xingu....78
Egeria densa....89
Egeria najas....89
Eichhornia azurea....90
Eichhornia crassipes....152
Eichhornia diversifolia....90
Elatine triandra....91
Eleocharis acicularis....91
Eleocharis parvula....92
Eleocharis vivipara....92
Eleocharis setaceum....93
Eustralis stellata....132
Eriocaulon cinereum....93

F

Fittonia argyronanta....171

G

Glossostigma diandrum....94
Glossostigma elatinoides....94
Gymnocoronis spilanthoides....95
Gymnocoronis spilanthoides 'Variegated'....95

H

Hemigraphis colorata....171
Hemigraphis colorata 'Exotica'....171
Hemigraphis colorata 'Exotica Narrow Leaf'....172
Hemigraphis repanda....172
Hemigraphis species....172
Hemigraphis species 'Mini'....172
Heteranthera dubia....96
Heteranthera zosterifolia....96
Hottonia palustris....97
Houttuynia cordata....97
Hydrilla verticillata....98
Hydrocharis dubia....153
Hydrodeis nymphaeoides....153
Hydrocotyle leucocephala....98

Hydrocotyle sibthorpioides....99
Hydrocotyle verticillata....99
Hydrotriche hottoniiflora....99
Hygrophila corymbosa....100
Hygrophila corymbosa 'Compacta'....101
Hygrophila corymbosa var. angustifolia....100
Hygrophila corymbosa var. salicifolia....100
Hygrophila corymbosa var. siamensis....101
Hygrophila corymbosa var. siamensis 'Small Leaf'....101
Hygrophila difformis....101
Hygrophila difformis 'Variegated'....102
Hygrophila lacustris....102
Hygrophila polysperma....102
Hygrophila polysperma 'Broad Leaf'....102
Hygrophila polysperma 'Narrow Leaf'....103
Hygrophila polysperma 'Rosa Nervis'....103
Hygrophila species 'Pantanal Wavy'....103
Hygrophila species 'Red'....103
Hygrorhyza aristata....154

I

Isoetes velata....31

L

Lagarosiphon madagascarensis....104
Lagarosiphon major....104
Lagenandra ovata....105
Lagenandra thwaitesii....105
Lilaeopsis brasiliensis....106
Lilaeopsis species 'Mauritius'....106
Limnobium laevigatum....154
Limnophila aquatica....107
Limnophila aromatica....107
Limnophila 'Brownii'....107
Limnophila hippuroides....108
Limnophila sessiliflora....108
Limnophila species 'Gigantea'....108
Lindernia rotundifolia....109
Lindernia rotundifolia 'Variegated'....109
Lobelia cardinalis....110
Lobelia cardinalis 'Small Form'....110
Ludwigia arcuata....111
Ludwigia brevipes....111
Ludwigia grandulosa....112
Ludwigia inclinata....112
Ludwigia inclinata 'Green'....112
Ludwigia ovalis....113
Ludwigia palustris....113
Ludwigia palustris 'Green'....113
Ludwigia perennis....113
Ludwigia sedioides....155
Ludwigia species....114
Ludwigia repens....114
Lysimachia nummularia....115
Lysimachia nummularia 'Aurea'....115

M

Marsilea angustifolia....31
Marsilea crenata....32
Marsilea quadrifolia....32
Mayaca fluviatilis....116
Mayaca sellowiniana....116
Micranthemum micranthemoides....117
Micranthemum umbrosum....117
Microcarpaea minima....118
Microsorium pteropus....33
Microsorium pteropus 'Narrow Leaf'....33
Microsorium pteropus 'Tropica'....34
Microsorium pteropus 'Windelov'....34
Myriophyllum aquaticum....119
Myriophyllum dicoccum....119
Myriophyllum elatinoides....119
Myriophyllum hippuroides....120
Myriophyllum matogrossense....120
Myriophyllum pinnatum....121
Myriophyllum x 'propinum'....121
Myriophyllum procerpinacoides....119
Myriophyllum propinquum....122
Myriophyllum spicatum....122
Myriophyllum scabratum....121
Myriophyllum tuberculatum....123

N

Najas guadalupensis....124
Najas indica....124
Nesaea pedicellata....125
Nesaea species....125
Nuphar japonica 'Spatterdock'....126
Nuphar saggittifolium....126
Nymphaea micrantha....127
Nymphaea rubra....127
Nymphaea species 'Green'....127
Nymphaea species 'Red'....128
Nymphaea lotus 'Green'....128
Nymphaea lotus 'Red'....128
Nymphaea stellata....128
Nymphaea zenkeri 'Green'....128
Nymphaea zenkeri 'Red'....128
Nymphoides aquatica....129
Nymphoides indica....155
Nymphoides peltata....156
Nymphoides species....129

O

Ophiopogon jaburan....173
Ophiopogon jaburan 'Variegatus'....173
Ophiopogon japonica....173
Ophiopogon japonica 'Kyoto'....173
Ottelia alismoides....130
Ottelia ulvifolia....130

P

Peliosanthes species....174
Pellia endiviifolia....24
Peplis diandra....71
Physostegia purpurea....131
Pista stratiotes....156

Pogostemon stellatus 'Broad Leaf'.....132
Pogostemon stellatus 'Narrow Leaf'.....132
Polygonum pedunculare.....133
Polygonum species.....133
Potamogeton crispus.....134
Potamogeton gayi.....134
Potamogeton malaianus.....135
Potamogeton octandrus.....135
Potamogeton perfoliatus.....136

R

Ranalisma rostrata.....137
Riccia fluitans.....25
Riccia species 'Dwarf'.....25
Rorippa aquatica.....137
Rotala indica.....138
Rotala macrandra.....138
Rotala macranda 'Green'.....139
Rotala macranda 'Green Narrow Leaf'.....139
Rotala macrandra 'Narrow Leaf'.....139
Rotala macrandra 'Variegated'.....139
Rotala mexicana.....140
Rotala najean.....140
Rotala occultifolia.....140
Rotala rotundifolia.....140
Rotala rotundifolia 'Green'.....141
Rotala wallichii.....141
Rotala wallichii 'Long Leaf'.....141

S

Sagittaria platyphylla.....142
Sagittaria subulata.....142
Salvinia natans.....157
Salvinia oblongifolia.....157
Samolus parviflorus.....143
Saururus cernuus.....143
Schismatoglottis species.....174
Selaginella wildenowii.....175
Shinnersia rivularis.....144
Shinnersia rivularis 'Variegatus'.....144
Spathiphyllum cannaefolium.....175
Spathiphyllum petite.....176
Spathiphyllum species.....176
Spathiphyllum wallisii.....176
Syngonium podophyllum.....177
Syngonium podophyllum 'Red Knight'.....177
Syngonium species 'White Butterfly'.....177

T

Tonina fluviatilis.....145
Tonina species.....145
Trapa natans.....158
Trichomanes javanicum 'Aqua Fern'.....178
Trichomanes javanicum 'Borneo Fern'.....178
Trichocoronis rivularis.....144
Trichocoronis rivularis 'Variegatus'.....144

U

Utricularia species.....158

V

Vallisneria americana var. americana.....146
Vallisneria americana var. americana 'Marmor'.....146
Vallisneria americana var. americana 'Rubra'.....146
Vallisneria americana var. americana 'Rubra Serpenta'.....147
Vallisneria americana var. biwaensis.....147
Vallisneria americana var. natans.....147
Vallisneria asiatica var. biwaensis.....147
Vallisneria caulescens.....148
Vallisneria gigantia var. biwaensis.....147
Vallisneria natans var. biwaensis.....147
Vallisneria spiralis.....148
Vallisneria spiralis 'Leopard'.....148
Vallisneria spiralis 'Tortifolia'.....149
Vallisneria spiralis var. contortionist.....149
Vesicularia dubyana.....27
Vesicularia species.....27

Notes

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